FOREWORD

In order to identify viable production alternatives for farmers in the pilot area of the Vietnam Finland Forestry Sector Co-operation Programme in Cho Don District of Bac Thai Province it is crucial to know markets for different potential products and also options for appropriate technologies to be applied. The Programme's idea is to study these aspect in several phases so that the results could be combined with other crucial information such as results of the participator rural appraisal and studies of ecology and economy of the forest resources.

The Programme started to study local markets and appropriate technologies in the pilot area in the end of September 1996 by contracting a team of consultants. The team comprised Mr. Jukka Tissari, Mr. Juha Kiuru, Dr. Tran Tuan Nghia, and Ms. Ho Thanh Huyen.

This is the second technical report of the Programme and is produced by the consultants. The consultants mission was finalised in a workshop in Cho Don District on 14 to 15 November 1996 where the findings and recommendations were analysed together with Programme staff, representatives of relevant province and district level institutions, the District' People's Committee, commune and village leaders and representatives of local forest industries. We want to thank the consultants and all the participants who have contributed to
this study.

Mr. Nguyen Van Viet
Director of the Programme

Mr. Petri Lehtonen
Chief Technical advisor

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1. EXECUTIVE SUMMARY

Demand Outlook for Wood and Non-Wood Forest Products

It is apparent that increasing population and economic activity will boost domestic demand for wood products throughout Vietnam, including the Programme area. Country's population is expected to reach 80-82 million capita in 2000. There is currently a booming construction sector which absorbs growing volumes of mechanical wood products (logs, sawnwood, plywood) and also bamboo products (trees, mats, boards). It is therefore concluded that there seems to be a strong demand for practically all wood products, exceeding supply and leading to roundwood shortages in the next 5 -10 years.

Non-wood forest products - in their enormous variety - have been an integral part of forest utilisation in Vietnam throughout the history. Numerous NWFPs are collected and also cultivated in the country, both for subsistence use, local and domestic markets and for exports. New industrial uses for NWFPs can still be discovered. It is estimated that the future demand for most of the non-wood forest products will clearly exceed the domestic supply. Market outlook for NWFPs is therefore promising.

How to reach the major markets (Thai Nguyen, Hanoi, rest of the country) from a distant mountainous region remains an obstacle for Cho Don district, unless transportation is improved.

Forest Resource Development - Recommendations:

1. Creation of planted forest gardens, preferably of multipurpose trees, would ensure sustainable resource base and production of fruit (Canarium spp.), bark (cinnamomum) or essential oils (anise) in the short term and timber and related products in the long term.

2. Planting of fruit trees together with increased apiculture would give fast results if suitable soil conditions are met.

3. Mixed planting of trees and fruit or agricultural products should be encouraged, as e.g. mixed growing of pineapple and multipurpose trees has proven profitable in other, provinces.
4. Mangletia and *Litsea cubeba* trees have proven suitable for shadow trees in e.g. tea plantations.

5. Due to the depletion of natural bamboo and rattan resources, their growing in home and forest gardens and around streams should be increased.

**Product Alternatives in the Short Term - Recommendations:**

1. Bamboo and rattan handicrafts (natural and planted): bamboo baskets, "knitted" bamboo mats, kitchenware, toothpicks, rattan furniture and baskets, etc.

2. Fruit trees (apricot, plum, persimmon, pear, custard apple, lychee, orange, mandarin, time)

3. Cinnamomum bark and anise seeds

4. Honey, beeswax, silk

5. Pine resin and rosin

6. Medicinal plants such as *Morinda officinalis* (root), *Amomum spp.* (fruit), *Artemisia annua* (leaves), *Eucnionia ulmoides* (bark), etc. Some species can also be grown in home gardens or planted in mixed stands with forest trees to improve farmers' income.

Regarding wood products, immediate action should be taken to:

1. Increase the sales of value-added products instead of unprocessed logs

2. Improve the existing yield and quality of sawnwood

3. Improve quality of furniture

4. Introduce new products such as toothpicks, incense-burning sticks, ice cream sticks and wood handicrafts

**Product Alternatives in the Long Term - Recommendations:**

1. In the long term, crude processing of essential oils (cinnamonomum, pemou and *Litsea cubeba*) in a pilot cottage plant could be considered, as the investment requirement is fairly low. This would add value in the final product.

2. Bamboo mats could be fairly easily processed into multi-layer glued bamboo boards, suitable for constructional uses.

3. Bamboo waste from Cho Don chopstick factory could be turned into a constructional board with a simple technology.

4. New production alternatives such as small-scale veneer/plywood based on Styrax spp., and bamboo plywood, particleboard from rice waste could be considered in the future.

**Training Needs**

1. More training in the making of market research and the appropriate use of the results in economic planning and extension work could be given in a special course.
2. A more detailed country-level market study should be carried out on selected priority products. This would help in analysing the economic viability of various production alternatives.

3. Study tours for interested farmers could be organised to selected villages who are successfully producing the proposed products.

4. Concerning the increased fruit tree cultivation, the Research Institute of Vegetables & Fruit in Hanoi is capable and qualified to organize training courses in the villages and in Hanoi.

5. A similar training input could be offered in agroforestry systems by the University of Agriculture and Forestry in Thai Nguyen.

Future Activities

1. Consultant team proposes the following activities to be carried out in the next phase of the Programme. These activities could be carried out jointly with the local staff and the consultants.

2. Guidelines for preparing local/national level market studies could be prepared.

3. Establishment of a simple feedback market information system is recommended. Using the existing extension workers’ network, basic information on buyers, processors, quality requirements and prices should be transferred to farmers on bi-weekly or monthly basis on e.g. blackboards in Cho Don or by video and fair. Also published prices of e.g. Hanoi newspapers could be distributed in Cho Don.

4. Organising of producers’ groups in order to sell the products in a centredised manner to agents or middlemen. Together they would exercise a stronger bargaining power over middlemen.

Findings of the Appropriate Technology Study:

- The following are the findings and conclusions of the appropriate processing technology study:

- There is a lack of awareness about importance of forest resources and possibilities in utilization of it for the sustainable rural development as whole

- At the moment it seems that forest management practices have not been implemented by considering and following the sustainable forest management principles due to the lack of knowledge and skills of the subject, which indeed is a major problem in planning, developing and implementing wood and non-wood processing activities.

- Availability of appropriate forest resources information based on inventories about wood and non-wood raw material resources, available wood species, location of forest areas etc. is not adequate and accurate.

- At the moment agriculture is the main source of income for the households and farmers do not have good understanding about the forest resources and how to use them for better income generation, employment opportunities and as an alternative for agriculture activities.

- Attitude towards conservation, reforestation and utilization of forest resources is
inadequate leading to over exploitation and unsustainable use of the existing forest resources.

- Generally low working motivation among the rural people towards heavy and poorly paid forest work.

- From the total consumption of wood raw material a portion of fuel wood is far too high as compared to the commercial use of raw materials, no accurate and concrete records were available for the research of raw material utilization.

- People in the pilot villages use a lot of time and effort for the collection and preparation of their daily fuel woods instead of organizing centralised fuel wood preparation, procurement and storing.

- There is a lack of know how and skills in forestry harvesting and wood and non-wood processing operations.

- Labour force at village level is abundant and a big advantage in the development of the forestry sector as whole, but possibilities to employ people in processing of wood and non-wood products is low.

- In the pilot villages, there is a high demand on appropriate training and extension services for the improvement of knowledge and skills of rural people.

- The level of existing technologies in forest harvesting operations and processing of wood and non-wood is low.

- Volume of waste, produced during the preparation of fuelwood and logs, is high due to the unappropriate working techniques and tools/equipment used in forest harvesting operations and in fuel wood preparation.

- In the pilot villages, there are some small scale wood processors, although development and improvement of the operations and small-scale wood processing sector as whole, should be implemented.

- Non-wood raw materials such as bamboo and rattan are very much existing, but processing of them is still very limited and should be developed in order to create better income and more employment.

- Other non-wood products such as fruits, mushrooms, essential oils, medical trees e.g. are not processed due to the fact that people in the rural areas do not know the opportunities in growing, processing and selling of the non-wood products. Therefore extension work at village level should be carried out in order to create better understanding of the given opportunities in growing and processing of non-wood products.

- There is a need to carry out a research on possible marketable wood species which are not known at the moment and can bring some valuable rawmaterial for wood processing operations.

- In Cho Don district manpower for forest harvesting operations is easily available and labour costs are moderate.

- Demand and use of fuelwood is high compared to the use of commercial wood and therefore a balance to this serious problem should be found through sustainable forest
management practices.

- In wood processing very basic processing technologies are used for converting wood into sawn timber to be used for different type of construction purposes
- From non-wood materials only bamboo is processed mainly for the local construction, household and irrigation purposes
- At the moment there is no training available for the forest owners and farmers although it is evidently very much needed.
- In improvement and development of the wood and non-wood processing technologies the key aspect of the success is to develop and implement appropriate training and extension programmes
- Buffaloes are used very efficiently, as draught animals, in extracting and transporting the raw materials particularly form the forest to the roadside, but can also be used for transport of raw materials for a longer distances from the road side to the possible manufacturing places in the villages. It is for wet, terrain and can be easily trained.
- One important aspect of processing technology is development of new technologies, working techniques, machinery, equipment and tools as well as improvement of the existing ones.

Recommendations of the Appropriate Technology Study:

The technology study results show quite clearly that in developing the existing wood and non-wood processing technologies their will be activities that should take place and begin immediately in order to develop and improve the living standard of rural people, increase income and employment opportunities at village level, decrease the deforestation, improve utilisation of raw material resources and last but not least to secure sustainability of forest as whole.

Future Activities:

The following activities are recommended:

- Improvement and development of reliable and sustainable forest management activities to support utilization of forest resources through appropriate processing operations
- Introduction and development of appropriate manual working methods to be applied in forest harvesting and wood and non-wood processing activities Establishment, development and implementation of extension and training programme for the training of farmers and rural people as whole
- Improvement and development of hand tools for harvesting and fuelwood operations
- Development of appropriate extraction and transport means and methods for wood and non-wood raw materials and products to be applied at village level
- Training of rural people in appropriate use of fuelwood and preparation of suitable raw materials (logs) for commercial uses
- Development of non-wood processing technologies to be applied in the villages
- Development of simple and small scale wood processing technologies to be applied for
utilising the small diameter wood rawmaterials

- Improvement and development of use, collection, transport and making of firewood

- Appropriate tools, equipment and machinery development for the small scale technologies to be applied in the pilot areas

In order to achieve sustainable use of existing forest resources and continues development of processing technologies together with sustainable forest management practices it is highly recommended that the following development activities should be implemented in long term bases:

- Further development of more sophisticated wood processing technologies such as sawing operations, small scale veneer peeling and particleboard manufacturing, furniture manufacturing etc.

- Development of more mechanised wood harvesting and transport systems to be applied in thinning and regeneration operation as soon as the appropriate forest management practices are under the implementation

- Establishment of credit systems for the investments in wood and non-wood processing technologies

- Product and design development in further processing of wood and non-wood products such as furniture, wood panels, bamboo corrugated roofing materials, bamboo boards, bamboo mats, handicrafts etc.

- Establishment of credit systems for the farmers to enable them for small investments while developing the forestry and wood processing sectors and establishing new employment opportunities and processing units to the pilot villages

**PART I  INTRODUCTION**

**2.BACKGROUND**

**2.1 Objectives**

This report summarises the findings of the first market research and appropriate processing technology consultancies on wood and non-wood forest products (also known as special products) conducted in the Vietnam - Finland Forestry Sector Co-Operation Programme. Objectives of the consultancies were:

(1) Market Research

(a) Identify market possibilities for wood and non-wood products which have potential in Cho Don District, with specific focus on immediate application of the results in the pilot villages. (b) Improve capacity of the local staff to carry out market studies.
(2) Appropriate Processing Technologies

(a) Identify appropriate technical alternatives for wood and non-wood processing in the pilot communes in Cho Don District.

(b) Improve capacity of the local staff to analyse production alternatives.

2.2 Scope of the Study

(1) Geographic Scope

The first market study covers the local markets which refer here to the Cho Don District and Province of Bac Thai. In certain products, e.g. bamboo, it was necessary to widen the local market to include also the nearest consumption and processing centre Hanoi. In certain non-wood forest products (e.g. essential oils and medicinal plants) most of the Vietnamese production is sold overseas, so exports were briefly discussed in those products. However, the more detailed national-level and export market studies should follow during 1997.

The study on appropriate technologies was based on a similar approach.

(2) Products

A wide range of wood and non-wood forest products were considered in the market study, ranging from firewood and industrial roundwood production to special products such as bamboo and rattan, pine resin and even edible fruit and essential oils obtained from Cinnamomum and other species.

The common Vietnamese classification of non-wood products (also known as "special products") divides them into two different groups:

Group 1 Bamboo, rattan, straw, etc. (utilised for their fibrous materials)

Group 2. Fruit trees, oil trees, medicinal plants, wild honey, shellac, pine resin, etc.

The following definition of non-wood forest products (NWFP) is adopted internationally:

NWFPs consist of goods of biological origin other than wood, as well as services derived from forests and allied land uses.

Study on appropriate processing technologies was more narrowly focused on wood products and only selected special products, viz. bamboo and rattan.

It has to be stressed that the product scope applied is far from comprehensive, as Vietnam is home to a very large number of wood and non-wood forest products. List of common Vietnamese non-wood products is attached in Annex 1.

2.3 Methodology

(1) Market Research

The various activities carried out during the market research process are summarised in Figure 2.1.

After a brief study design, the work started with desk research where the relevant domestic and international information was gathered and analysed. Supporting statistical data was
collected from research and government organisations in Hanoi.

Fieldwork was initiated with visits to the Bac Thai Department of Agriculture and Rural Development (Thai Nguyen) and pilot villages (Cho Don) in the project area. The resources, capabilities and development needs of the local people were reviewed. The approach was systematic and participatory in both lines of research.

Based on the findings, the checklists for structured fieldwork interviews for the market study were prepared. Interviews were carried out in about three weeks time in the Bac Thai province. Producers, buyers, middlemen, shopkeepers, processors, industry representatives and rural and urban end-users of wood and non-wood products were interviewed. A survey of around 55 households was conducted in Bang Lung (40) and the villages (15). A list of contacts during the work is enclosed in Annex 2.

The total demand for various products was analysed in Bac Thai province level, as the Cho Don district alone, with its 46 000 people, represents an insignificant market system with only subsistence use in many products.

(2) Appropriate Processing Technologies

For methodology of appropriate wood and non-wood processing technologies, see Part 2 of this report.

Figure 2.1: Methodology of Market Research
2.4 Organisation of the Work

The work was carried out jointly by a team of four consultants. However, the Team separated in two parts (1 international + 1 local cons.) when the technology study was commenced. The two studies were, however, symbiotic and closely interlinked during the entire project period.

Consultant team:

- Mr. Jukka Tissari, international consultant, market research
- Mr. Juha Kiuru, international consultant, appropriate technology
- Dr. Tran Tuan Nghia, local consultant
- Ms. Ho Thanh Huyen, local consultant

In addition, local staff members (4) participated in the work during the two weeks of fieldwork.
A period of two months (23.9 -15.11.1996) was used for the market research by international and local consultants. The study on appropriate technologies was conducted in one month time during 21.10 -15.11.1996. The findings of the both studies were presented in a dissemination workshop in Cho Don.

3. GENERAL INFORMATION ON BAC THAI PROVINCE AND CHO DON DISTRICT

3.1 Area and Population

Total land area of Bac Thai province is 139.336 ha, of which forest land covers 47.237 or 30% (Table 3.1). Cho Don district covers more than 9.873 ha. Around 55% (5.176 ha) of the total Cho Don area is classified as forest land. In conclusion, Cho Don district has a large concentration of land suitable for intensified forestry production.

Table 3.1 Land Use in Bac Thai Province and Cho Don District (1993)

<table>
<thead>
<tr>
<th>Type of land</th>
<th>Bac Thai Province Area (ha)</th>
<th>Cho Don District Area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest land</td>
<td>47.237</td>
<td>5.176</td>
</tr>
<tr>
<td>Agricultural land</td>
<td>68.352</td>
<td>2.748</td>
</tr>
<tr>
<td>Housing</td>
<td>9.044</td>
<td>259</td>
</tr>
<tr>
<td>Water facing area for fishery</td>
<td>1.529</td>
<td>92</td>
</tr>
<tr>
<td>Unused land allocation</td>
<td>13.174</td>
<td>1.599</td>
</tr>
<tr>
<td>Total</td>
<td>139.336</td>
<td>9.873</td>
</tr>
</tbody>
</table>

Sources: Investigation of rural and agriculture in 1994 in Bac Thai province Statistical Division, Cho Don

Bac Thai Province has around 1.19 million inhabitants (Table 3.2). Population growth has been on average 2.3% per year in the province in the 1990s. The capital Thai Nguyen has a population of 188 000 people. Population density in the province is 180 persons/km$^2$. Around 81% of the population live in rural areas. Kinh people are the majority group with a 68% share.

Cho Don is one of the ten rural districts in Bac Thai. It is home to roughly 46 000 inhabitants, or 3.8% of the total province population. The average population density is 50 persons/km$^2$. The most density populated communes have, however, more than 100 people/km$^2$. There are 21 communes and one town in the district (Bang Lung). The rural population growth in Cho Don District has been somewhat faster (3% per annum) than average growth in the province. Tay people form the majority in Cho Don (76%).

Table 3.2 Population in Bac Thai Province and Cho Don District

|--------|------|------|------|------|------|--------------|
3.2 Economy

In Vietnam's GDP, the Sector I (agriculture, forestry and fishery) is traditionally very important. In 1994, the Vietnamese GDP amounted to 39 982 bill. dong, of which the output of Sector I accounted for 14 169 bill. dong. (35%).

Bac Thai province represents only a small concentration of economic activity in Vietnam. The province accounts for 2% of the land area, 1.6% of population and around 3.5% of the roundwood production of the country (Table 3.3).

Table 3.3 Gross Output by Economic Activity in Bac Thai Province 1991-1993

<table>
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<tr>
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<tbody>
<tr>
<td>- bill. VND, constant 1989 prices -</td>
<td></td>
<td></td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>Industry total, of which:</td>
<td>216.0</td>
<td>256.9</td>
<td>287.2</td>
<td>1.4</td>
</tr>
<tr>
<td>- central</td>
<td>166.5</td>
<td>203.5</td>
<td>228.5</td>
<td>2.2</td>
</tr>
<tr>
<td>- local</td>
<td>49.5</td>
<td>53.4</td>
<td>58.7</td>
<td>0.6</td>
</tr>
<tr>
<td>Construction</td>
<td>22.2</td>
<td>35.0</td>
<td>48.5</td>
<td>1.3</td>
</tr>
<tr>
<td>Food production (1 000 tons paddy equivalent)</td>
<td>182.6</td>
<td>226.6</td>
<td>268.2</td>
<td>1.1</td>
</tr>
<tr>
<td>Forestry (1 000 m$^3$)</td>
<td>8.33</td>
<td>39.7</td>
<td>100.4</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: Statistical data of agriculture, forestry and fishery 1985-1995

The main industrial centre is the capital Thai Nguyen with mining, steel and paper industries. The construction sector has enjoyed a remarkable growth in Bac Thai. Although forestry production is a prominent sector in Bac Thai, the total value of roundwood production and wood processing has turned to a decline due to the resource depletion in the recent years (Table 3.4). The number of forest products processing units (state and private) declined to around 300 in 1995, compared to 715 units in 1993.

Table 3.4 Selected Economic Indicators in Bac Thai Province 1991-1995

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Average income in Bac Thai</td>
<td>0.8</td>
<td>1.00</td>
<td>1.14</td>
<td>1.41</td>
<td>1.69</td>
</tr>
</tbody>
</table>
Bac Thai Province belongs to the Northern mountainous ecological zone of Vietnam. The area lies in 20-23th South latitude and is affected by the North-East monsoon. Average temperature is 21-23°C, in winter temperatures fall to 15-19°C with dew. Rainfall is distributed rather regularly throughout the year so no dry season occurs. Average rainfall is 1600-2 400 mm/year, maximum 4 000 mm. Atmospheric humidity is at the highest around 80% in the spring.

Forest lands in Bac Thai are characterised by elevations from 200 m to over 2000 m and slopes of 15-30 degrees. Soils are typically feraletic, formed of degenerated stone or sandstone. Soil depth is above 50 cm and it is of average fertility only, mainly due to the depletion of natural forest. A typical forest phenotype is a secondary, poorly stocked forest or bush of 2-3 metres in height. Only scattered large-size trees occur in areas of difficult access. Large tracts of the hillsides are actually denuded from any permanent forest cover.

The climatic and topographic conditions result in diverse plant systems. Both tropical, subtropical and temperate wood species thrive in the region. This enables the growing of exotic, cold/temperate climate plantation woods (e.g. Quercus sp p., Castanea spp.) and fruit trees (e.g. plum, apple, pear, peach) in the region.

The climate in Cho Don district is tropical and half-tropical characteristic, micro-early, frozen climate and in the longer time compared with other district in BacThai province. Average temperature is 20,9°C. minimum temperature is 8°C, maximum temperature is 38°C. Average rainfall is 1822 min. Maximum raining month is August (341 mm), minimum raining months is February and March (22.6 mm & 30,1 mm). Average atmospheric is over 80%.

Forest land in Cho Don district have average high 300-600m, including maximum top is 1326m and slopes of 15-25°.

### 3.4 Forest Resources

#### 3.4.1 Forest Area

Bac Thai province has around 122 000 ha of natural forest, of which 50 000 ha is protected (Table 3.5). Most of the remaining 72 000 ha of production forests consist of broad-leaved forests. But very little rich or normal condition broad-leaved forests exist. Poor-condition forests (24 000 ha) and regenerated young forests (20 000 ha) cover the most extensive areas in Bac Thai's natural forests. Bamboo covers around 22 000 ha, of which 14 000 ha are found in mixed forests.
In addition to the classified forest area, Bac Thai province has 266,000 ha of denuded and bare lands in the mountainous regions which could have potential in forestry. It also has to be noted that a large number of scattered trees have been planted in home gardens and along roads and irrigation canals. The quantity of wood in this resource base remains unknown.

Table 3.5 Natural Forest Area by Type in Bac Thai Province (1992)

<table>
<thead>
<tr>
<th>Forest Area by Type</th>
<th>Bac Thai Province - hectares -</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Production forest</td>
<td></td>
</tr>
<tr>
<td>a. Special forest</td>
<td>72,202</td>
</tr>
<tr>
<td>b. Seed forest</td>
<td>1,532</td>
</tr>
<tr>
<td>c. Other production forest</td>
<td>70,670</td>
</tr>
<tr>
<td>- broadleaved forest</td>
<td></td>
</tr>
<tr>
<td>- rich forest (&gt; 150 m$^3$/ha)</td>
<td>n.a.</td>
</tr>
<tr>
<td>- medium forest (80-150 m$^3$/ha)</td>
<td>4,149</td>
</tr>
<tr>
<td>- poor forest (&lt;80 m$^3$/ha)</td>
<td>24,395</td>
</tr>
<tr>
<td>- regenerated (secondary forest)</td>
<td>19,849</td>
</tr>
<tr>
<td>- bamboo in mixed forest</td>
<td>14,003</td>
</tr>
<tr>
<td>- bamboo forest</td>
<td>8,247</td>
</tr>
<tr>
<td>2. Protection forest</td>
<td>49,528</td>
</tr>
<tr>
<td>- bamboo</td>
<td>n.a.</td>
</tr>
<tr>
<td>Total Forest Area</td>
<td></td>
</tr>
<tr>
<td>- natural forest</td>
<td>121,730</td>
</tr>
<tr>
<td>- bamboo</td>
<td>22,250</td>
</tr>
</tbody>
</table>

Source: Statistical Yearbook of Forestry 1992

Cho Don district has a total forest area of around 64,989 ha, of which 40,550 ha is actually barren land. The existing forest land covers therefore 24,439 ha, including a few hundred ha of plantations. Plantation forests have been established during the implementation of 327 and PAM-programmes. Their total area is not known, but several hundred hectares have been annually established in the 1990s (Table 3.6).

Altogether, 17 species of multipurpose and timber-producing trees had been planted by the farmers interviewed in Cho Don pilot villages. Main species planted include e.g. Pinus khesiya, Pinus massoniana, Styrax tonkinensis, Quercus spp., Mangletia glauca, Canarium
spp, *Cinnamomum* spp., *Eucalyptus* spp., etc. The quality and surviving rate of the planted and regenerated areas was not available.

### 3.4.2 Growing Stock

The volume of wood and bamboo in the natural forests of Bac Thai and Cho Don is reported for the year 1992 in the latest statistics. The inventory is carried out in five year intervals so new data will be released again in 1997.

The total growing stock of natural forests was 7.4 mill. m$^3$ in Bac Thai province in 1992 (Table 3.7). Roughly 3.9 mill. m$^3$ were in the production forests while the remaining 3.5 mill. m$^3$ were protected. Most of the resources were in poor-condition or regenerated young forests (around 2.7 mill. m$^3$) which are not available for immediate utilisation. Bamboo inventory showed a total of 83 million trees, mainly in mixed and bamboo forests.

Forests of Cho Don district contain a growing stock of just below one million cubic metres in the production forests (1992 data). This was quite evenly distributed with the remaining broadleaved forests (mainly of poor and regenerated forests) and mixed forests.

Forest area controlled by Cho Don Forest Enterprise is 5 960 ha, containing round timber reserves in the magnitude of 160 000 m$^3$.

#### Table 3.6 Annual Planting and Regeneration Rate of Forest in Cho Don 1991-1995

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Planted:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- by state</td>
<td>11.45</td>
<td>-</td>
<td>-</td>
<td>339.81</td>
<td>176.21</td>
</tr>
<tr>
<td>- by farmers</td>
<td>36.78</td>
<td>19.40</td>
<td>284.59</td>
<td>507.24</td>
<td>195.41</td>
</tr>
<tr>
<td>Subtotal</td>
<td>48.23</td>
<td>19.40</td>
<td>284.59</td>
<td>339.81</td>
<td>176.21</td>
</tr>
<tr>
<td>Natural Regeneration:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- by state</td>
<td>49.60</td>
<td>48.22</td>
<td>108.85</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>- by farmers</td>
<td>36.78</td>
<td>19.40</td>
<td>284.59</td>
<td>507.24</td>
<td>195.41</td>
</tr>
<tr>
<td>Subtotal</td>
<td>86.38</td>
<td>67.62</td>
<td>393.44</td>
<td>507.24</td>
<td>195.41</td>
</tr>
<tr>
<td>Grand Total</td>
<td>134.61</td>
<td>87.02</td>
<td>678.03</td>
<td>847.05</td>
<td>371.62</td>
</tr>
</tbody>
</table>

Source: Statistical Division, Cho Don

#### Table 3.7 Growing Stock of Forests and Bamboo in Bac Thai Province and Cho Don District in 1992 (Natural Forests)

<table>
<thead>
<tr>
<th>Growing Stock by Forest Type</th>
<th>Bac Thai Province</th>
<th>Cho Don District</th>
</tr>
</thead>
<tbody>
<tr>
<td>- cubic metres -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Production forest</td>
<td>3 912 874</td>
<td>994 538</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>---------------</td>
<td>---------------</td>
</tr>
<tr>
<td>a. Special forest</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>b. Seed forest</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>c. Other production forest, of which:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- broadleaved forest:</td>
<td>3 912 874</td>
<td>994 538</td>
</tr>
<tr>
<td>- rich forest (&gt; 150 m$^3$/ha)</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>- medium forest (80-150 m$^3$/ha)</td>
<td>3 159 086</td>
<td>506 602</td>
</tr>
<tr>
<td>- poor forest (&lt;80 m$^3$/ha)</td>
<td>1 606 548</td>
<td>330 752</td>
</tr>
<tr>
<td>- regenerated (secondary) forest</td>
<td>1 132 518</td>
<td>117 260</td>
</tr>
<tr>
<td>- wood from Mixed forest</td>
<td>753 787</td>
<td>487 936</td>
</tr>
<tr>
<td>- bamboo in mixed forest (1000 trees)</td>
<td>36 578</td>
<td>27 598</td>
</tr>
<tr>
<td>- bamboo forest (1 000 trees)</td>
<td>34 038</td>
<td>9 012</td>
</tr>
<tr>
<td>2. Protection forest</td>
<td>3 487 775</td>
<td>333 823</td>
</tr>
<tr>
<td>- bamboo (1000 trees)</td>
<td>12 775</td>
<td>1 085</td>
</tr>
<tr>
<td><strong>Total Growing Stock</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Natural forest (m$^3$)</td>
<td>7 400 649</td>
<td>1 328 361</td>
</tr>
<tr>
<td>- Bamboo (1 000 trees)</td>
<td>83 391</td>
<td>37 695</td>
</tr>
</tbody>
</table>

Source: Statistical Yearbook of Forestry 1992
Statistical Division, Cho Don
4. CURRENT CONSUMPTION OF WOOD AND NON-WOOD FOREST PRODUCTS IN CHO DON DISTRICT AND BAC THAI PROVINCE

4.1 General

Before 1988, only state forest enterprises (SFE) were entitled to produce logs. Private exploitation was allowed only for house construction, and a certain amount of illegal logging existed. Since 1988, the SFEs have allocated part of their forest lands to their workers who can exploit the forest privately. Private log producers have to pay a stumpage fee which is 40% of the roadside price.

Nowadays the share of illegal logging is estimated at around 20-40% of the total roundwood supply.

The Vietnamese market is not very transparent for research due to its dual nature. Production in State Forest Enterprises is usually well documented, as they operate under the direct control of Departments of Agriculture and Rural Development (DARD). The private processing - especially illegal producers - seem to work without control or recording by the authorities. In addition, there are SFEs under the jurisdiction of several other ministries. It is estimated that the production and processing of logs in private companies and under other ministries is around four times larger than the sector controlled by DARD - around 80/20 - ratio is presumed in Bac Thai province.

Data for 1994 were the latest complete figures on consumption, so they have been taken as a base the analysis.

4.2 Wood Products

4.2.1 Consumption Patterns in Bac Thai

4.2.1.1 Fuelwood

Fuelwood is still the main wood product consumed in Bac Thai, like throughout Vietnam. About half a million cubic metres have been annually consumed by households (mainly for cooking) and industry of the province (Table 4.1). Only state-controlled production is included here. Fuelwood represents around 90% of the total state-controlled wood consumption in the region. Typical industrial uses of fuelwood are brick making, lime burning and tea curing.

It has to be noted that the subsistence use of fuelwood by farmers is not statistically reported in Vietnam. Farmers and other rural households can freely extract fuelwood from the forests. Wood remains the most important source of energy for the rural households.
It is expected that the fuelwood demand will be quite steady in the future, as there are only limited substitution from other sources of energy (electricity, coal, agro-waste). Substitution will take place close to coalmines and along the main roads and cities, but in the rural areas wood remains the primary fuel. Farmers prefer to use agricultural waste for improving soil fertility.

Unless the efficiency of cooking stoves is improved, the demand for fuelwood will grow in parallel with the population.

4.2.1.2 Roundwood

High-quality roundwood is rarely consumed in Bac Thai, as a major part of the wood belongs to Group 8 which comprises the lowest-value timbers only. Around 71 000m$^3$ of industrial roundwood from DARD-controlled companies were consumed in 1994 (Table 4.1). The real volumes are naturally higher, as private sector and illegal log production (or production under other ministries) cannot be traced. Based on the 80/20 rule, the total log consumption would be around 355 000m$^3$.

Supportive wooden pillars have been used in the mines of Bac Thai, but this consumption has reportedly declined in 1996 due to escalating prices. On average 18 000m$^3$ of mangletia and eucalyptus wood, together with natural species, have been delivered annually for this purpose by the Bac Thai Forest Produce Company.

4.2.1.3 Other Products

The actual wood processing accounts for minor share of the total wood usage in Bac Thai. Consumption of DARD-controlled sawnwood (6 400m$^3$) and furniture has declined in the recent years. The real volumes of sawnwood consumed are presumably four times higher than reported here, maybe around 32 000m$^3$. The leading processors reported that shortage of logs has lead to reductions in capacity utilisation rates.

Most of the paper material consumed refers to bamboo, where Cho Don district is an important source.

**Table 4.1 Consumption of Major Wood Products in Bac Thai Province (DARD - Controlled Industry)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fuelwood (m$^3$)</td>
<td>467 639</td>
<td>525 000</td>
<td>506 346</td>
<td>494 480</td>
<td>511 322</td>
</tr>
<tr>
<td>2. Roundwood (m$^3$)</td>
<td>89 177</td>
<td>95 000</td>
<td>104 440</td>
<td>70 600</td>
<td>62 111</td>
</tr>
<tr>
<td>- of which Group 8 species</td>
<td>59 477</td>
<td>69 875</td>
<td>92 284</td>
<td>43 150</td>
<td>n.a.</td>
</tr>
<tr>
<td>3. Mining timber (m$^3$)</td>
<td>n.a.</td>
<td>18 000</td>
<td>18 000</td>
<td>18 000</td>
<td>18 000</td>
</tr>
<tr>
<td>4. Sawnwood (m$^3$)</td>
<td>2 798</td>
<td>3 784</td>
<td>6 817</td>
<td>6 353</td>
<td>3 520</td>
</tr>
<tr>
<td>5. Furniture (m$^3$ roundwood equiv.)</td>
<td>529</td>
<td>561</td>
<td>2 626</td>
<td>3 061</td>
<td>735</td>
</tr>
</tbody>
</table>
4.2.2 Consumption Patterns in Cho Don

Among the 55 households interviewed in Cho Don district, the annual average fuelwood consumption was 5 m$^3$ in Ban Lung and 10 m$^3$ in the villages. Assuming on average 6 persons per household and a 70% share of rural population, it is estimated that the demand for fuelwood in Cho Don district amounts to 65 000 in' per year.

DARD-permitted roundwood production levels have fallen considerably in 1995 (Table 4.2), amounting to less than 500 m$^3$. Including the wood and bamboo resources harvested for paper production, around 2 000 m$^3$ have been annually cut in the 1990s. However, this does not reveal the actual harvest and consumption levels, as considerable amount of wood is being purchased from local farmers. Also illegal cutting operations harvest logs from the remaining natural forests, sold to the middlemen on the roadside.

Several hundred cubic metres of unprocessed logs (Groups 5-6) are sold from Cho Don State Forest Enterprise to the Bac Thai Forest Products Processing Company in Thai Nguyen. The logs are usually 3-5 metres long and have a diameter of 30-40 cm. There are some small-scale horizontal bandsaws operating in Bang Lung and numerous pitsawing units in the villages. They use obsolete, locally made technology and continue to waste wood. The bandsaws supply sawnwood for the local carpenters and furniture workshops in Bang Lung. Largest part of the sawnwood is, however, used for house construction. A simplified analysis on sawnwood demand for housing in Cho Don is presented in the following:

**Assumptions:**

- population growth: 3%/yr
- annual increase 45 743 x 0.03 = 1 390 inhabitants (230 households, with 6 members each)
- average sawnwood consumption: 10 m$^3$/house, resulting in 2 300 m$^3$ additional demand every year.
- economic life span of houses: 25 years, resulting in 4% replacement rate every year
- replacement of the existing houses: 0.04 x 7 624 = 305 replacements/yr., consuming 3 050 m$^3$ of sawnwood

Total sawnwood consumption for house construction:

\[
2 300 \text{m}^3/\text{yr. (new houses)} + 3 050 \text{m}^3/\text{yr. (replacements)} = 5 350 \text{m}^3/\text{yr. (total consumption)}
\]
Table 4.2 DARD-Controlled Production of Timber and Bamboo in Cho Don District 1991-1995

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Roundwood (m³)</td>
<td>882</td>
<td>1061</td>
<td>720</td>
<td>812</td>
<td>459</td>
</tr>
<tr>
<td>Paper material</td>
<td>871</td>
<td>694</td>
<td>765</td>
<td>961</td>
<td>n.a.</td>
</tr>
<tr>
<td>(styrax and bamboo, tons)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sawnwood (m³)</td>
<td>908</td>
<td>1626</td>
<td>1507</td>
<td>231</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

Source: Forestry Station Cho Don

4.2.3 Projections for 1996

According to the Department of Agriculture and Rural Development in Thai Nguyen, less than 5 000 m³ of industrial roundwood will be produced in Bac Thai by the State Forest Enterprises in 1996 (Table 4.3). This only represents the enterprises controlled by DARD, while the total volumes are presumably a lot higher (around 22 000 m³).

Table 4.3 Planned Consumption of Wood Products in Bac Thai in 1996 (Under Department of Agriculture and Rural Development)

<table>
<thead>
<tr>
<th>Product</th>
<th>Planned Consumption in 1996</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Roundwood (all types)</td>
<td>4 477 m³</td>
</tr>
<tr>
<td>- natural styrax</td>
<td>2 300 m³</td>
</tr>
<tr>
<td>- plantation pine &amp; styrax</td>
<td>880 m³</td>
</tr>
</tbody>
</table>

Source: Department for Agriculture & Rural Development of Bac Thai Province

Cho Don district is projected to supply 12% (556 M3) of the total roundwood requirements of Bac Thai's state forest enterprises in 1996 (Table 4.4). Cho Don is more important in the production of natural styrax, accounting for 22% (500 M3) of Bac Thai's consumption in 1996 (Table 4.5).

Table 4.4 Planned Production and Processing of Roundwood in State Forest Enterprises of Bac Thai in 1996 (Under Department of Agriculture and Rural Development)
Table 4.5 Planned Production and Processing of Pine and Styrax in State Forest Enterprises of Bac Thai in 1996
(Under Department of Agriculture and Rural Development)

<table>
<thead>
<tr>
<th>Forest Enterprise</th>
<th>Production Plan</th>
<th>Processing Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plantation</td>
<td>Processing company</td>
</tr>
<tr>
<td></td>
<td>Total Styrax</td>
<td>Total Pine</td>
</tr>
<tr>
<td>Total</td>
<td>4 477 1 856 2 039 100 200 100 200 50 216</td>
<td>3 180 414 466 2 300 2714 1414 700 400 200</td>
</tr>
<tr>
<td>1. Dong hy</td>
<td>825 500 325</td>
<td></td>
</tr>
<tr>
<td>2. Bach thong</td>
<td>940 940</td>
<td></td>
</tr>
<tr>
<td>3. Cho don</td>
<td>556 300 50 100 106</td>
<td></td>
</tr>
<tr>
<td>4. Phu luong</td>
<td>694 494 50 50 100</td>
<td></td>
</tr>
<tr>
<td>5. Vo nhai</td>
<td>375 175 100 50 50</td>
<td></td>
</tr>
<tr>
<td>6. Na ri</td>
<td>460 200 50 100 110</td>
<td></td>
</tr>
<tr>
<td>7. Dinh hoa</td>
<td>250 250</td>
<td></td>
</tr>
<tr>
<td>8. Phu binh</td>
<td>200 150 50</td>
<td></td>
</tr>
<tr>
<td>9. Brigade380</td>
<td>470 470</td>
<td></td>
</tr>
</tbody>
</table>

Source: Department for Agriculture & Rural Development of Bac Thai Province
4.2.4 End-Uses

Roundwood

There is a wide variety of household uses for round timber in Cho Don. The main end-uses of roundwood are naturally fuelwood and buildings. There are two basic types wooden houses in Cho Don district.

1. A typical toy farmer's wooden house is built on wooden stilts. It consumes mostly sawnwood and bamboo in walls and floor, but wooden poles are used in load-bearing structures (corner poles, roof). Houses have typically 50-60 m² floor space.

2. A smaller (30-15 m²) wooden house type is built on the ground and consumes less timber. The use of large bamboo is more common in these low-cost houses.

Construction poles are also sold to city dwellers by lengths of 7-10 metres and by 10-20 cm bottom diametres. Mangletia is a commonly sold species in Thai Nguyen.

Sawnwood

A typical Tay farmers' wooden house on stilts needs around 19m³ of timber (sawnwood and structural poles). Around 15m³ is directed to wall structures. Continuous repairs and rustic furniture also require sawnwood, but the best quality sawnwood is processed into high-quality furniture in Bang Lung and Thai Nguyen.

4.2.5 Quality Requirements

Typical quality requirements for roundwood and wood products are presented in Table 4.6. There is a common Vietnamese grading system for e.g. sawnwood, but it is poorly followed by the small-scale; sawmillers. As the availability of high-quality logs continues to decline, a new, simplified grading rule is under preparation.

Table 4.6 Quality Requirements of Wood Products

<table>
<thead>
<tr>
<th>Product</th>
<th>Quality Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Round timber</td>
<td>(Φ = 30-60 cm; length: 3.5-5 m)</td>
</tr>
<tr>
<td>2. Mining timber</td>
<td>(Φ &gt; 8 cm, length: 7-10 m)</td>
</tr>
<tr>
<td>3. Sawnwood</td>
<td>Length: &gt;2.2 in; width: &gt;20 cm; thickness: &gt;10 cm</td>
</tr>
<tr>
<td>4. Veneer</td>
<td>from round wood of group 3.4</td>
</tr>
<tr>
<td>5. Plywood</td>
<td>Size: 1.22 x 2.44 x 0.003-0.02 m</td>
</tr>
<tr>
<td>6. Fibreboard</td>
<td>Sheet size: 1 x 2 in, thickness: 3-6 mm</td>
</tr>
<tr>
<td>7. Chipboard</td>
<td>Sheet size: 1.75 x 3.65 m, thickness: 8-20 mm</td>
</tr>
<tr>
<td>8. Furniture</td>
<td>from wood of groups 1, 2, 3, 4</td>
</tr>
</tbody>
</table>
4.2.6 Distribution Channels

Along with the adoption of doi moi policy, individual smallholders, farmers, forest users and state forest enterprises are all involved in the production, distribution and trade of wood and non-wood forest products in Vietnam. The role of state forest enterprises has been reduced from the past.

Distribution channels of wood and non-wood forest products tend to be complex, involving several middlemen (traders) who are taking their share of the profit but adding little or no value to the product (Figure 4.1). There are reportedly two kind of wholesalers involved in the trade:

1. Private, unregistered wholesalers

2. Registered wholesalers who are part of state forest enterprises

Figure 4.1 Distribution Channels in Logs and Wood Products

Middlemen can be both useful and harmful for smallholders. They are important in providing the following services: quick credit, quick and non-bureaucratic payment and good organisation. They are often the only working centralised collecting and transportation organisation available for scattered rural producers.

On the other hand, middlemen often unfairly exploit producers who have only limited knowledge on end-uses, market demand and prices of their products. Although precise prices of the middlemen were not obtained, the following rough estimates are presented based on secondary materials (Group 1-2 logs):

- the price of logs grows three-fold when sold to unregistered wholesalers
- the price of logs grows 8-10 times higher when sold to registered wholesalers (who pay taxes)
- finally, logs are sold to processors or export markets on prices that are 12-18 times higher than those received by private producers

Marketing and distribution should be simplified in order to ensure higher profits to the private producers.

4.2.7 Prices
Regional price information was collected during the work for the analysis of pricing structures along the distribution chain. There are clearly three high-value species being sold, viz. *Chucrasia spp.*, *Parapentace spp.* and *Talauma gioi*. Their prices are 3-4 higher than those of common utility species (Table 4.7). However, their prices are only modestly higher in Thai Nguyen (10-15%).

The low-price timbers fetch around 0.4-0.65 mill. dong in Thai Nguyen, what is 1.25-2.5 times higher than prices quoted in Cho Don. The sawmills in the outskirts of Hanoi are reportedly buying logs on average prices of 0.7-0.8 mill. dong/m^3^.

**Table 4.7 Unit Prices of Roundwood by Region (Nov. 1996)**

<table>
<thead>
<tr>
<th>Roundwood</th>
<th>Price in Cho Don</th>
<th>Price in Thai Nguyen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species</td>
<td>- mill. Dong/m^3^ -</td>
<td></td>
</tr>
<tr>
<td><em>Chucrasia spp.</em></td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td><em>Parapentace spp.</em></td>
<td>0.6</td>
<td>1.5</td>
</tr>
<tr>
<td><em>Talauma gioi</em></td>
<td>0.45</td>
<td>1.2</td>
</tr>
<tr>
<td><em>Mangletia glauca</em></td>
<td>0.20-0.25</td>
<td>0.4</td>
</tr>
<tr>
<td><em>Eucalyptus spp.</em></td>
<td>0.4</td>
<td>0.32</td>
</tr>
<tr>
<td><em>Canarium spp.</em></td>
<td>0.38</td>
<td>0.55-0.6</td>
</tr>
<tr>
<td><em>Castanopsis fissa</em></td>
<td>0.38</td>
<td>0.6</td>
</tr>
<tr>
<td><em>Quercus poilanei</em></td>
<td>0.38</td>
<td>0.6</td>
</tr>
<tr>
<td><em>Styrax tonkinensis</em></td>
<td>0.10-0.22</td>
<td>0.32</td>
</tr>
<tr>
<td><em>Cassia arabica</em></td>
<td>0.38</td>
<td>0.6</td>
</tr>
<tr>
<td>Mining timber</td>
<td>0.22-0.25</td>
<td>0.45</td>
</tr>
</tbody>
</table>

The price of fuelwood doubles between Cho Don and Thai Nguyen and nearly triples in Hanoi. Prices are highly influenced by transportation costs. Sawnwood price increases 1.4-fold (Thai Nguyen) and 2-fold (Hanoi). Prices for veneer and wood-based panels were observed only in the cities (Table 4.8).

**Table 4.8 Unit Prices of Forest Products by Region (Oct. 1996)**

<table>
<thead>
<tr>
<th>Wood Products</th>
<th>Price in Cho Don</th>
<th>Price in Thai Nguyen</th>
<th>Price in Hanoi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>- mill. Dong/m^3^ -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuelwood</td>
<td>0.05-0.08</td>
<td>0.12</td>
<td>0.18</td>
</tr>
<tr>
<td>Sawnwood</td>
<td>0.65-0.8</td>
<td>1.1</td>
<td>1.6-1.8</td>
</tr>
<tr>
<td>Veneer</td>
<td>n.a.</td>
<td>1.6-2.0</td>
<td>1.4</td>
</tr>
</tbody>
</table>
Prices for commonly used furniture were collected in Cho Don. Prices naturally depend on the quality of wood and design. Normally, fine furniture in Cho Don is manufactured of Group 3-4 species. Locally manufactured set of four chairs and a table was priced at 1.7-2 mill. dong. Tall cupboard was quoted at 1.7 mill. dong and low cupboard at 0.5-0.7 mill. dong.

4.3 Non-Wood Forest Products

4.3.1 General

A large variety of NWFPs or non-wood forest products (aka “special products”) are being produced in Vietnam. The natural forests in Vietnam have possessed rich reserves of plants suitable for nutrition, medicine, handicrafts, fuel, fodder and construction materials. NWFPs often play an important role in providing supplement and side dishes to agricultural crops, especially during seasonal shortages.

The diversity of the NWFP resources is evident from the following list of species available in Vietnam (Table 4.9).

Table 4.9 Number of Species Yielding Non-Wood Forest Products in Vietnam

<table>
<thead>
<tr>
<th>Type of Non-Wood Forest Product</th>
<th>Number of Species in Vietnam</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fibres</td>
<td>242</td>
</tr>
<tr>
<td>2. Resins</td>
<td>113</td>
</tr>
<tr>
<td>3. Essential oils</td>
<td>458</td>
</tr>
<tr>
<td>4. Fatty oils</td>
<td>473</td>
</tr>
<tr>
<td>5. Tannin</td>
<td>800</td>
</tr>
<tr>
<td>6. Medicine</td>
<td>557</td>
</tr>
<tr>
<td>7. Starch</td>
<td>27</td>
</tr>
</tbody>
</table>

Due to the depletion of natural forests, also plantation-based non-wood products have emerged. Sustainable use of these products has proven essential in upland community forestry worldwide. In many cases, NWFPs can yield higher economic returns than upland agriculture or forest products on a similar area. It is also important to notice that urbanisation of the population can actually increase the demand for NWFPs, as people moving from rural areas maintain and disseminate their consumption patterns in the city. This phenomenon is sometimes called the "nostalgia" market.

In Vietnam, subsistence use and local markets continue to absorb most of the NWFPs, but increasing volumes are sold to international markets, where demand for "green" products of natural origin is rising. Vietnam used to be an important exporter of many non-wood
products before the war-period, and has recently re-established its trade relations to e.g. Western Europe. China remains a hard competitor for Vietnam in export markets.

A list of common Vietnamese non-wood forest products is presented in Annex 1, summarising also their recent production volumes. This study concentrates on a limited number of products, based on the resources, capabilities and future plans of the local farmers in Cho Don district.

4.3.2 Consumption and End-Use Patterns

4.3.2.1 Fibres: bamboo and rattan

Bamboo is the dominant non-wood forest product in Bac Thai due to its multiple applications and relatively rich reserves in the province. However, the DARD-controlled consumption volumes turned to a steep decline after 1991-1992 (Table 4.11). Around 2 mill. trees of thick bamboo were used in 1995, compared to 31 mill. trees in 1991. Although exact figures are missing for slender bamboo, its consumption has declined below 2 mill. trees in 1994.

In Cho Don district, the planned bamboo utilisation levels would be 2 030 tons for paper, 300 tons of thick bamboo and 3 000 tons of slender bamboo (Table 4.10). This is 43% of the total in Bac Thai. The chopstick factory of Cho Don State Forest Enterprise is the only industrial user of bamboo in the district, consuming 30 000 trees per month. 10 communes are supplying the bamboo by contract. 70% of the material is sold as bamboo waste to Hoang Van Thu paper company in Thai Nguyen. The chopstick production is sold through Thang Long company (Hanoi) to Dong Hoa company in Ho Chi Minh city to be exported to Taiwan.

Table 4.10 Planned Production and Processing of Bamboo in State Forest Enterprises of Bac Thai in 1996

<table>
<thead>
<tr>
<th>Forest Enterprise</th>
<th>Production Plan</th>
<th>Paper Processing Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>For paper</td>
<td>Thin bamboo</td>
</tr>
<tr>
<td>Total</td>
<td>8 193</td>
<td>4 000</td>
</tr>
<tr>
<td>1. Bach thong</td>
<td>2 900</td>
<td>1 000</td>
</tr>
<tr>
<td>2. Cho don</td>
<td>2 030</td>
<td>3 000</td>
</tr>
<tr>
<td>3. Phu luong</td>
<td>2 140</td>
<td></td>
</tr>
<tr>
<td>4. Dinh hoa</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>5. Vo nhai</td>
<td>223</td>
<td></td>
</tr>
<tr>
<td>6. Brigade 380</td>
<td>500</td>
<td></td>
</tr>
</tbody>
</table>

Source: Department for Agriculture & Rural Development of Bac Thai Province

Bamboo has numerous applications in Cho Don communes’ everyday life. Houses are partly built of structural poles of bamboo, and splitted bamboo is practically the only flooring material in rural houses. It is also used in roofs, partition walls and bamboo mats. Bamboo is widely applied in the transmission of electricity (poles) and water (pipes). Fences are often
made of bamboo. A large number of household items and handicrafts are manufactured of bamboo. Bamboo cages and baskets play an important role in the transportation of animals and food.

Young bamboo shoots have been increasingly harvested for food. Most of them consumed fresh (1300 tons in 1995). Restrictions on bamboo shoot harvest have been imposed to sustain regeneration of the stands. Bamboo has also been widely cultivated by the farmers. The common species include *Arundinaria spp.*, *Neohouzeana dulloa*, and *Phyllostachys pubescens*. Altogether, around 150 species are reported to grow in Vietnam.

Rattans or climbing palms belong to *Calamoideae* scientific family. Around 30 species of rattans grow in Vietnam. Reliable data on rattan production is currently almost non-existent in Vietnam. The value of rattan production increased fast in the late-1980s, reaching 10 billion dong in 1990. Vietnam exported 2,000 tons (6 mill. pieces) of rattan handicrafts worth USD 2.5 million in 1991. Demand for rattan in export markets is very strong and supply shortages are reported.

Sporadic deliveries of natural rattan were observed in Cho Don district. Some rattan is transported to Hanoi for processing into furniture in the Barotex company. Some attempts have been made to establish rattan plantations in the area. *Calamus tetradacrylus* and *C. tenuis* are the two planted species.

**Table 4.11 Consumption of Major Non-Wood Forest Products in Bac Thai Province 1991-1995**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Slender bamboo (mill. trees)</td>
<td>4.69</td>
<td>7.47</td>
<td>3.75</td>
<td>1.85</td>
<td>n.a.</td>
</tr>
<tr>
<td>2. Thick bamboo (mill. trees)</td>
<td>31.16</td>
<td>17.21</td>
<td>4.56</td>
<td>1.25</td>
<td>2.0</td>
</tr>
<tr>
<td>3. Fresh bamboo shoots (tons)</td>
<td>200</td>
<td>2000</td>
<td>300</td>
<td>290</td>
<td>1300</td>
</tr>
<tr>
<td>4. Dry bamboo shoots (tons)</td>
<td>20</td>
<td>20</td>
<td>24</td>
<td>24</td>
<td>n.a.</td>
</tr>
<tr>
<td>5. Palm leaves (mill. leaves)</td>
<td>2.55</td>
<td>2.0</td>
<td>2.9</td>
<td>2.8</td>
<td>2.895</td>
</tr>
<tr>
<td>6. Pine resin (tons)</td>
<td>15.5</td>
<td>12.8</td>
<td>15</td>
<td>12.6</td>
<td>11</td>
</tr>
<tr>
<td>7. Rosin (Colophonium) (tons)</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>10-15</td>
</tr>
<tr>
<td>8. Tung oil (tons)</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>18-20</td>
</tr>
<tr>
<td>9. Mushroom (tons)</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>15</td>
</tr>
<tr>
<td>10. Apricot (tons)</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>400</td>
</tr>
</tbody>
</table>

Source: Statistical Division, Thai Nguyen

In Cho Don, the production of slender bamboo has varied a lot in the 1990s. The highest output level was attained in 1994 when nearly 2,000 tons were produced. However, in 1995 there was a drastic reduction to 255 tons.

**4.3.2.2 Palm leaves**

Palm leaves are extensively utilised in thatching of rural and suburban houses and cottages. Annual consumption levels have risen to nearly 3 mill. leaves in 1995 (Table 4.11). This product sold in bundles of 50 or 100 leaves. A 15 cm thick layer of leaves is usually
constructed with an average consumption of 45 leaves per square metre. Maximum of ten leaves can be removed from a palm tree once a year. *Livistona saribus* Merr. and *Cheval* is the common species harvested for this purpose.

### 4.3.2.3 Resins and gums

Various oleoresins can be tapped from living trees. Pine resin can be further processed into rosin (Colophonium) or turpentine. They are widely used in the production of natural paints, varnish, inks and glues.

Bac Thai province and Cho Don district have suitable conditions for growing *Pinus merkusii*, *P. massoniana* and *P. kesiya* which are all tapped to produce resin. *P. merkusii* is usually the preferred species for the quality of its resin. Annual consumption of pine resin has varied between 11-15 tons in Bac Thai. Around 10-15 tons of colophonium was consumed in 1995. Current pine resin/rosin shortages in export markets indicate potential for increased production in Vietnam, where labour costs are low.

Another relevant product is benzoin obtained from *Styrax tonkinensis*. Styrax is grown in Bac Thai but mainly for matches and pulpwood. Only in special conditions some styrax trees produce the high-value benzoin resin. In the recent years, Vietnam has exported around 10 tons of benzoin to France.

### 4.3.2.4 Essential oils

Essential oils are volatile mixtures of organic compounds derived from odorous plant materials such as flowers, herbs, fruit, roots and wood. They are used in fragrance and food industries and pharmaceutical products.

In Northern Vietnam, small cottage distillation units are the primary processors of essential oils, as the products require immediate distillation after harvest. The crude oils are then gathered to Enteroil company in Hanoi for refining and quality control. Enteroil is the biggest further processor and licensed exporter of essential oils in Vietnam. It holds an estimated 70-80% market share in essential oils in Vietnam. According to their estimates, there are nine major species of essential oils being produced and exported (Table 4.12). The bulk of the output is of three species: sassafras, star anise and citronelia oils. There is very little domestic market for essential oils so practically all of it is exported, mainly to Western Europe (France) and Japan.

#### Table 4.12 Production of Essential Oils in Vietnam in 1995 (Enteroil Company, Hanoi)

<table>
<thead>
<tr>
<th>Essential Oil</th>
<th>Production (tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cassia oil (Cinnamomum)</td>
<td>10-15</td>
</tr>
<tr>
<td>2. Citronella oil</td>
<td>200-350</td>
</tr>
<tr>
<td>3. Ocimum basilicum oil</td>
<td>10</td>
</tr>
<tr>
<td>4. Peppermint oil</td>
<td>15-20</td>
</tr>
<tr>
<td>5. Star anise seed oil</td>
<td>200-300</td>
</tr>
<tr>
<td>6. Cajeput oil</td>
<td>10-12</td>
</tr>
<tr>
<td>7. Litsea cubeba oil</td>
<td>10-15</td>
</tr>
</tbody>
</table>
Cinnamomum is a multipurpose tree, as all its parts are of high economic value. Bark is exploited from the trunk and branches, essential oil is extracted from leaves and small branches, fruits are used in medicine and food. The timber obtained from large trees is good for processing furniture, etc.

Eucalyptus essential oil can be produced from the leaves of e.g. *Eucalyptus camaldulensis* and *E. exserta*, but the product is suffering low prices in international markets. It may have some domestic market potential in pharmaceutical uses in Vietnam.

In addition, there are other by-products that are being sold to exports, such as star anise flowers and seeds (200-300 tons/yr.) and benzoin gum from various species (10 tons/yr.). Actually, the anise seeds obtain better economic returns than anise oil. Around 8 kg of seeds are needed to produce one kg of anise oil. However, the price for oil is only double compared to the price for seeds. Vietnamese anise is of superior quality and e.g. China has imported anise seeds from Vietnam in order to upgrade its essential oil quality for the world markets. Most of Vietnam's anise exports is in seeds and flowers.

*Aleurites montana* seeds are processed for tung oil which is not an essential oil but rather a fast-drying, heat-resistant fatty oil which is applied in varnishes and mixed with lac. Around 18-20 tons of tung oil was produced in Bac Thai in 1995. Other fatty oils produced in Vietnam include e.g. castor oil and cashew oil.

### 4.3.2.5 Medicinal Plants

Most medicines prescribed by traditional healers in Vietnam originate from natural forests. Various parts of the plants, which are usually collected from the wild, can be used for medicine: roots, fruits, leaves, seeds, bark, tubers, etc. Among the common species are: *Morinda officinalis* (root), *Cinnamomum* spp. and *Amomum* spp. (fruit), *Artemisia annua* (leaves), *Eucmonia ulmoides* (bark), etc. Some species can also be grown in home gardens or planted in mixed stands with forest trees to improve farmers' income.

Due to their low weight and high value, medicinal plants are easily transported to distant markets. Some medicinal plants are currently enjoying stronger international demand because traditional pharmaceuticals are being rediscovered in Western markets due to their harmless, natural ingredients. On the other hand, it is foreseen that a different consumption pattern will emerge in Vietnam. Rising income levels presumably direct domestic demand to processed medicines.

It is estimated that 80-90% of medicinal plants produced in Northern Vietnam are exported in the form of dried plants or extracts. Of special interest is a new anti-malaria drug obtained from *Artemisia annua*.

### 4.3.2.6 Mushrooms

Mushrooms are commonly grown by rural households, usually on wood poles or rice waste pad, and stored, consumed and traded mostly in dried form. Rural households usually grow or collect mushrooms mainly for subsistence. Wood ear mushroom and Jew's ear mushroom (*Auricularia auricular* and *A. polytricha*) are common species in Vietnam. The only species which is also collected in the natural forest in Northern Vietnam is called perfume mushroom (*Lentinus edodes*) for its distinctive smell. Presumably, the 10-15 IS tons annually consumed in...
Bac Thai refer to this species which is better known as *shiitake* (jap.) in the world markets.

Forest mushrooms are reportedly collected and marketed locally in Cho Don, but the actual quantities remained unknown during this research.

### 4.3.2.7 Fruit

The potential offered by fruit trees has not yet been fully realised in Cho Don district. The ongoing French-supported project has introduced new species for home gardens in the district. During the off-season months of Cho Don fruit, expensive imported (Chinese or from Hanoi) fruit are being sold in the local marketplaces. The average consumption of fruit per capita is very low (6 kg) in Vietnam, so there is a large potential demand in the domestic market. This potential is available in two ways:

1. by increasing total demand, since fruit have a high income elasticity, i.e. consumption tends to increase sharply along with rising income levels,

2. by substituting the imported fruit from China.

According to the Research Institute of Fruits & Vegetables in Hanoi, there are at least 11 species that are being cultivated in Bac Thai and could be considered in Cho Don district. (Table 4.13). Apricot has been the most widely cultivated species in Bac Thai province, covering nearly half of the total area (3 100 ha). Yellow and green type of apricots appear to be the most suitable species for Cho Don district (Table 4.14).

#### Table 4.13 Areas of Main Fruit Trees in Bac Thai (1995)

<table>
<thead>
<tr>
<th>Fruit Species</th>
<th>Area (ha)</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tropical fruit trees</strong></td>
<td>1 239.5</td>
<td>19.49</td>
</tr>
<tr>
<td>Banana</td>
<td>639.5</td>
<td>10.06</td>
</tr>
<tr>
<td>Pineapple</td>
<td>173.0</td>
<td>2.72</td>
</tr>
<tr>
<td>Custard apple</td>
<td>427.0</td>
<td>6.71</td>
</tr>
<tr>
<td><strong>Asian tropical fruit trees</strong></td>
<td>1 541.1</td>
<td>24.23</td>
</tr>
<tr>
<td>Litchi (lychee)</td>
<td>504.9</td>
<td>2.94</td>
</tr>
<tr>
<td>Orange, Mandarin</td>
<td>398.0</td>
<td>6.26</td>
</tr>
<tr>
<td>Persimmon</td>
<td>300.4</td>
<td>4.59</td>
</tr>
<tr>
<td>Lime</td>
<td>234.7</td>
<td>3.69</td>
</tr>
<tr>
<td>Longan</td>
<td>103.1</td>
<td>1.62</td>
</tr>
<tr>
<td><strong>Temperate fruit trees</strong></td>
<td>3 261.5</td>
<td>51.28</td>
</tr>
<tr>
<td>Apricot</td>
<td>3 136.6</td>
<td>49.32</td>
</tr>
<tr>
<td>Plum</td>
<td>124.9</td>
<td>1.96</td>
</tr>
</tbody>
</table>
4.3.2.8 Honey

It would be a natural step to increase the production of honey along with the intensified cultivation of fruit trees in Cho Don. Improved pollination in the orchards would be achieved, contributing to higher yield of fruit.

Based on a Hanoi-based honey exporting company, the Northern provinces of Vietnam produce only a few hundred tons of honey, which is mainly sold in the domestic markets. Forest honey collected in the forests (*Apis dorsata* bee) would obtain higher prices due to its superior quality and medicinal properties. Around 2000-4000 tons of honey is annually produced in Vietnam. This could be increased by integrated beekeeping with forest management.

4.3.2.9 Insect Products: Sticklac and Silk

The following two insect products are considered to offer potential for expansion in Northern Vietnam. Detailed information was not, however, available on production Bac Thai province. Both products are labour-intensive and could be suitable for cottage-industries in Cho Don.

*Sticklac* is a resinous substance exuded by lac insects (*Laccifera lacca*). Naturally occurring secretion is collected from the branches of numerous deciduous trees. A more common practice is the deliberate inoculation (= to introduce a disease by transmitting the agent which causes it) of host trees, either wild or cultivated. In Northern Vietnam, several species of plantation-grown *Ficus* spp. and *Acacia* spp. are host trees for lac insects. Two lac products are separated:

1. Seed lac: The crude product obtained directly from the trees, once particulate matter has been removed from the sticks (also known as sticklac).
2. Shellac: The product when the resin has been extracted.

Vietnam is not self-sufficient in lac products, as shellac has been imported from Laos, India and Thailand. The domestic production (around 80-140 tons per year) has not been able to meet the capacity of the processing companies. Shellac is used in e.g. electrical insulation, paints and varnishes.

Silk is obtained from the larvae of the silkworm moth. Different silk worm species and host trees are used to produce the following types of raw silk (Table 4.15). Demand for "wild" silk has remained steady although most of the world's silk is obtained from cultivated silk farms. Silk has a firm reputation as a natural fashion textile which fetches high unit prices. Vietnam is currently rehabilitating its sericulture industry.

**Table 4.15 Types of Silk Produced in Vietnam**

<table>
<thead>
<tr>
<th>Type of Silk</th>
<th>Silkworm</th>
<th>Common Host Trees</th>
<th>Colour of Silk</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mulberry</td>
<td><em>Bombyx mori</em></td>
<td><em>Morus alba</em></td>
<td>- shiny, cream white</td>
</tr>
<tr>
<td>2. Muga</td>
<td><em>Antheraea assamensis</em></td>
<td><em>Cinnamom obulusfolium</em>, <em>Litsea spp.</em>, <em>Machilus spp.</em></td>
<td>- golden</td>
</tr>
<tr>
<td>(only in</td>
<td></td>
<td><em>Magnolia Pterocarpa, etc.</em></td>
<td></td>
</tr>
<tr>
<td>India)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Eri</td>
<td><em>Philosamia cynthia</em></td>
<td><em>Ricinus communis (castor)</em></td>
<td>- creamy white</td>
</tr>
<tr>
<td>silk</td>
<td></td>
<td></td>
<td>- brick red</td>
</tr>
<tr>
<td>4. Tassar</td>
<td><em>Antheraea paphia</em></td>
<td><em>Quercus spp.</em>, <em>Shorea robusta</em>, <em>Bombax ceiba, etc.</em></td>
<td>- coloured</td>
</tr>
</tbody>
</table>

**4.3.3 Quality Requirements of Non-Wood Forest Products**

Quality requirements on selected non-wood products are given in the following, based on interviews of traders and processors.

**Bamboo and rattan**

Bamboo: length 7-10 metres, diametre 8-12 cm

Thick rattan: length 4.5 metres, diametre min. 1 cm

**Essential oils**

The key requirement in essential oils is the concentration of active compound found in the oil and the purity of the product. This is determined by e.g. the plant species available, harvest time, quality of primary processing and transportation. The active compound concentrations required in export trade are listed in (Table 4.16).

**Table 4.16 Quality Requirements of Essential Oils**
### 4.3.4 Distribution Channels

In the case of non-wood forest products, the distribution channels are often long due to the scattered resources and producers. Also, long distance and poor road connections to consumption centres necessitate the use of several traders and middlemen. As an example, bamboo mats/handicrafts produced by farmers reach urban end-users through a 6-step distribution chain (Figure 4.2). Some of the middlemen can be by-passed but usually there are several actors involved.

**Figure 4.2 Distribution Channels of Bamboo Mats and Handicrafts**

The distribution channel of medicinal plants is different, as one village (Ninh Hiep) near Hanoi dominates the collection, drying, quality grading and transportation of herbs and plants from Northern Vietnam (Figure 4.3). Individual exploiters receive only part of the revenues. In the trade of *Amomum xanthioides* (cardamom) the wholesalers price is about 30% higher than they pay for collectors. Exporter's price is another 20-25% higher.

**Figure 4.3 Distribution Channels of Medicinal Plants**

Ethnic and family ties (kinship) often play an important role in the structure of trade and

<table>
<thead>
<tr>
<th>Essential Oil</th>
<th>Active Compound Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cassia oil</td>
<td>Cinnamaldehyde: 80%</td>
</tr>
<tr>
<td>2. Citronella oil</td>
<td>Citronella/Geraniol: 35%/85%</td>
</tr>
<tr>
<td>3. Ocimum basilicum oil</td>
<td>Methyl chavicol: 85%</td>
</tr>
<tr>
<td>4. Peppermint oil</td>
<td>Menthol: 60%</td>
</tr>
<tr>
<td>5. Star anise seed oil</td>
<td>Anethol: 85%</td>
</tr>
<tr>
<td>6. Cajeput oil</td>
<td>Cineol: 70%</td>
</tr>
<tr>
<td>7. Litsea cubeba oil</td>
<td>Citral: 700%</td>
</tr>
<tr>
<td>8. Pemou oil</td>
<td>Fokienol/Nerolidol: 30%/20%</td>
</tr>
<tr>
<td>9. Sassafras oil</td>
<td>Safrole: 90%</td>
</tr>
</tbody>
</table>

Ethnic and family ties (kinship) often play an important role in the structure of trade and
distribution. The longer the distribution channel is, the smaller share of the final consumer’s price accrues to the farmer. In addition, the large number of middlemen also effectively reduces the flow of market information (on prices, buyers, volumes, end-uses, quality, etc.) to the primary producers.

Establishment of a market information system would improve farmers’ ability to gain fair prices for their products. Also producers’ groups could be established who sell their products in a centralised manner to agents or middlemen. Together they would exercise a stronger bargaining power over middlemen.

4.3.5 Prices

Indicative prices of various non-wood forest products were collected in order to assess their economic value to producers. Price data obtained concentrated on Hanoi, as it appeared to be the main consumption centre for most of the articles (Table 4.17-Table 4.20).

Many non-wood products are facing large price fluctuations for following reasons:

1. Seasonal harvest and demand
2. Quality (perishable products such as fruit)
3. Transportation problems
4. Several middlemen
5. Poor flow of market information to collectors

Table 4.17 Unit Prices of Bamboo and Rattan by Region (Oct. 1996)

<table>
<thead>
<tr>
<th>Non-Wood Forest Products</th>
<th>Price in Cho Don</th>
<th>Price in Thai Nguyen</th>
<th>Price in Hanoi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species</td>
<td>- VND/kg -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh bamboo shoot</td>
<td>-</td>
<td>3000-4000</td>
<td>4 500 -10 000</td>
</tr>
<tr>
<td>Dry bamboo shoot</td>
<td>20-35 000</td>
<td>2000</td>
<td>40-70 000</td>
</tr>
<tr>
<td>Thick bamboo (VN/tree)</td>
<td>3 500-4 000</td>
<td>10-20 000</td>
<td>10-20 000</td>
</tr>
<tr>
<td>Thin bamboo (VND tree)</td>
<td>1 500-2 000</td>
<td>7 000</td>
<td>6 500-8 000</td>
</tr>
<tr>
<td>Thick rattan (VND/m)</td>
<td>1 200</td>
<td>2 800</td>
<td>-</td>
</tr>
<tr>
<td>Thin rattan (VND/m)</td>
<td>2 100</td>
<td>3 500</td>
<td>-</td>
</tr>
<tr>
<td>Bamboo mat (2.4 x 4.55 m) (VND/mat)</td>
<td>25 000</td>
<td>18 000</td>
<td>-</td>
</tr>
<tr>
<td>Palm leaf (VND/leaf)</td>
<td>500</td>
<td>600</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 4.18 Unit Prices of Resins and Essential Oils by Region (Oct. 1996)
### Table 4.19 Unit Prices of Medicinal Plants and Mushrooms by Region (Oct. 1996)

<table>
<thead>
<tr>
<th>Non-Wood Forest Products</th>
<th>Price in Cho Don</th>
<th>Price in Thai Nguyen</th>
<th>Price in Hanoi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pine resin</td>
<td>-</td>
<td>4000</td>
<td>3500</td>
</tr>
<tr>
<td>Rosin (Colophonium)</td>
<td>-</td>
<td>5800</td>
<td>6000-6500</td>
</tr>
<tr>
<td>Turpentine (VND/litre)</td>
<td>-</td>
<td>3600</td>
<td>5000</td>
</tr>
<tr>
<td>Cinnamomum bark (30cm)</td>
<td>n.a.</td>
<td>n.a.</td>
<td>25300-27500</td>
</tr>
<tr>
<td>Anise flower</td>
<td>n.a.</td>
<td>n.a.</td>
<td>28600</td>
</tr>
<tr>
<td>Anise oil</td>
<td>n.a.</td>
<td>n.a.</td>
<td>110000</td>
</tr>
<tr>
<td>Cassia oil</td>
<td>n.a.</td>
<td>n.a.</td>
<td>55000-143000</td>
</tr>
<tr>
<td>Pemou oil</td>
<td>n.a.</td>
<td>n.a.</td>
<td>88000</td>
</tr>
</tbody>
</table>

### Table 4.20 Unit Prices of Fruits and Honey by Region (Oct. 1996)

<table>
<thead>
<tr>
<th>Fruit</th>
<th>Price in Cho Don</th>
<th>Price in Thai Nguyen</th>
<th>Price in Hanoi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longan</td>
<td>3000-5000</td>
<td>10000</td>
<td>12-20000</td>
</tr>
<tr>
<td>Litchi</td>
<td>-</td>
<td>18000</td>
<td>15-20000</td>
</tr>
</tbody>
</table>
5. CONCLUSIONS: PRODUCT ALTERNATIVES FOR CHO DON

5.1 Demand Outlook for Wood and Non-Wood Forest Products

It is apparent that increasing population and economic activity will boost domestic demand for wood products throughout Vietnam, including the Programme area. Country's population is expected to reach 80-82 million capita in 2000. There is currently a booming construction sector which absorbs growing volumes of mechanical wood products (logs, sawnwood, plywood) and also bamboo products (trees, mats, boards). It is therefore concluded that there seems to be a strong demand for practically all wood products, exceeding supply and leading to roundwood shortages in the next 5-10 years.

Demand for wood products is not a problem, but how to reach the major markets (Thai Nguyen, Hanoi, rest of the country) from a distant mountainous region remains an obstacle for Cho Don district, unless transportation is improved.

Non-wood forest products - in their enormous variety - have been an integrated part of forest utilisation in Vietnam throughout the history. Numerous NWFPs are collected and also cultivated in the country, both for subsistence use, local and domestic markets and for exports. A large part of the trade is not properly recorded. A growing international demand for natural products will help to re-establish export channels of Vietnamese non-wood products. The country has a clear cost advantage in export markets in products which are labour-intensive (e.g. resin). On the other hand, the domestic market is large and in many products per capita consumption is low. New industrial uses for NWFPs can still be discovered. Many products have a high unit value combined with low weight, what enables transportation from distant production areas. Market outlook for NWFPs is therefore promising.

It has to be noted that the selection of future products and planted species in Cho Don must be based on careful judgement of markets, local conditions, costs, technologies, resources and people's aspirations. Market study provides therefore only one component for the final decision making.

5.2 Forest Resource Development

It is generally believed that the high-value natural forest resources, will be exhausted in Vietnam within the next decade. In the meantime, increasing population and their higher consumption habits and purchasing power will increase the demand for most wood products.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Orange</td>
<td>6000</td>
<td>5500-6000</td>
<td></td>
</tr>
<tr>
<td>Plum</td>
<td>3000-4000</td>
<td>6000</td>
<td>8000-10000</td>
</tr>
<tr>
<td>Apricot</td>
<td>1000-5000</td>
<td>7000-12000</td>
<td>16000-20000</td>
</tr>
<tr>
<td>Mandarin</td>
<td>10000</td>
<td>8000</td>
<td>6000</td>
</tr>
<tr>
<td>Banana</td>
<td>2500-3000</td>
<td>4000</td>
<td>4000-5000</td>
</tr>
<tr>
<td>Canarium fruit (fresh)</td>
<td>-</td>
<td>3500</td>
<td>-</td>
</tr>
<tr>
<td>Honey</td>
<td>55-65000</td>
<td>-</td>
<td>20-35000</td>
</tr>
</tbody>
</table>
The role of plantation-grown wood will therefore be crucial to substitute dwindling indigenous forest reserves.

Forest ecosystem conservation and collection of NWFPs should be a priority in those areas where rich natural forest still exists. Knowing that this area is diminishing, reforestation activities are essential in maintaining the resource base in degraded areas.

The on-going reforestation programmes have focused on exotic timber-producing species. It is recommendable to increase the planting of indigenous multipurpose trees, providing both non-wood products and timber. The larger diversity of species used reduces also the economic risk for the individual farmer. 17 species of multipurpose and timber-producing trees had been planted by the farmers interviewed in Cho Don pilot villages. Main species planted include e.g. Pinus khesiya, Pinus massoniana, Styrax tonkinensis, Quercus spp., Mangletia glauca, Canarium spp, Cinnamomum spp., Eucalyptus spp., etc.

Recommendations:

1. Creation of planted forest gardens, preferably of multipurpose trees, would ensure sustainable resource base and production of fruit (Canarium spp.), bark (cinnamomum) or essential oils (anise) in the short term and timber and related products in the long term.

2. Planting of fruit trees together with increased apiculture would give fast results if suitable soil conditions are met.

3. Mixed planting of trees and fruit or agricultural products should be encouraged, as e.g. mixed growing of pineapple and multipurpose trees has proven profitable in certain provinces.

4. Mangletia and Litsea cubeba trees have proven suitable for shadow trees in e.g. tea plantations.

5. Due to the depletion of natural bamboo and rattan resources, their growing in home and forest gardens and around streams should be increased.

5.3 Product Alternatives in the Short Term

Immediate activities in the pilot villages should emphasise the production of non-wood forest products, because they create income to farmers already after 3-5 years. Priority products in the short term (< 5 years) are selected based on demand and the existing production alternatives which have already been started by Cho Don farmers. It is important to diversify the resource base, since very little natural forests remain in Cho Don.

Recommendations:

1. Bamboo and rattan handicrafts (natural and planted): bamboo baskets, "knitted" bamboo mats, kitchenware, toothpicks, rattan furniture and baskets, curtain stick, joss stick, etc.

2. Fruit trees (apricot, plum, persimmon, pear, custard apple, lychee, orange, mandarin, lime)
3. Cinnamomum bark and anise seeds

4. Honey, beeswax, silk

5. Pine resin and rosin

6. Medicinal plants such as *Morinda officinalis* (root), *Amomum spp.* (fruit), *Artemisia annua* (leaves), *Eucmonia ulmoides* (bark), etc. Some species can also be grown in home gardens or planted in mixed stands with forest trees to improve farmers' income.

Regarding wood products, immediate action should be taken to:

1. Increase the sales of value-added products instead of unprocessed logs

2. Improve the existing yield and quality of sawnwood

3. Improve quality of furniture

4. Introduce new products such as toothpicks, incense-burning sticks and ice cream sticks

### 5.4 Product Alternatives in the Long Term

New products can be introduced in a longer time span, as many suitable timbers require 20-30 years before sizable harvest can be obtained. It is urgent to create a credit system that acknowledges the needs of the farmers better than the existing credit schemes.

**Recommendations:**

1. In the long term, crude processing of essential oils (cinnamomum, and Litsea cubeba) in a pilot cottage plant could be considered, as the investment requirement is fairly low. This would add value in the final product.

2. Bamboo mats could be fairly easily processed into multi-layer glued bamboo boards, suitable for constructional uses.

3. Bamboo waste from Cho Don chopstick factory could be turned into a constructional board with a simple technology.

4. New production alternatives such as small-scale veneer/plywood based on *Styrax spp.*, and bamboo plywood, particleboard from rice waste could be considered in the future.

### 5.5 Training Needs

1. More training in the making of market research and the appropriate use of the results in economic planning and extension work could be given in a special course.

2. A more detailed country-level market study should be carried out on selected priority products. This would help in analysing the economic viability of various production p
alternatives.

3. Study tours for interested farmers could be organised to selected villages who are successfully producing the proposed products.

4. Concerning the increased fruit tree cultivation, the Research Institute of Vegetables & Fruit in Hanoi is capable and qualified to organize training courses in the villages and in Hanoi.

5. A similar training input could be offered in agroforestry systems by the University of Agriculture and Forestry in Thai Nguyen.

5.6 Future Activities

Consultant team proposes the following activities to be carried out in the next phase of the Programme. These activities could be carried out jointly with the local staff and the consultants.

1. Guidelines for preparing local/national level market studies could be prepared.

2. Establishment of a simple feedback market information system is strongly recommended. Using the existing extension workers' network, basic information on buyers, processors, quality requirements and prices should be transferred to farmers on bi-weekly or monthly basis on e.g. blackboards in Cho Don or by video and fair. Also published prices of e.g. Hanoi newspapers could be distributed in Cho Don.

3. Organising of producers' groups in order to sell the products in a centralised manner to agents or middlemen. Together they would exercise a stronger bargaining power over middlemen.

BIBLIOGRAPHY


6. INTRODUCTION

6.1 Objectives of the Study

The first objective of the study is to identify existing technologies in wood and non-wood forest harvesting and processing technologies and to recommend appropriate technologies to be applied in the pilot villages in Cho Don District. Purpose of appropriate technology is to increase and improve employment in forestry sector, business opportunities in the pilot villages, level of forestry and wood processing technologies, know-how and skills of the village people in applying the recommended technologies and to improve the socio economic aspects of the pilot villages through sustainable forest management and environment conservation to contribute for better living standard of the communes as whole.

The second objective is to improve capacity of local staff to analyse forest and wood processing technologies through problem analyses, material collection, field visits and in analysing of the existing technical conditions and collected materials to be summarised in the final study report and presented for workshop on the appropriate technologies.

6.2 Time and Venue of the Study

The study took place during the period of October 21st - November 13th 1996. The study was implemented in three different venues the first week being in Hanoi, the second period of one and half weeks in Thai Nguyen city and Cho Don District and the third period of one week in Hanoi. These field activities will be followed with a workshop at Bang Lung town, on marketing and processing of wood and non-wood forest products, for a one and half days on the 14th - 15th of November 1996.

6.3 Consultancy Team

Consultancy team consists of a local consultant Dr. Tran Tuan Nghia, Research Officer, Forest Science Institute of Vietnam, Hanoi and international consultant Mr. Juha Kiuru, Project Specialist, FTP International Ltd., Kotka Finland. During the field activities the team was assisted by Mr. Dong Khanh Hung, Technical Officer, Cho Don Forestry Enterprise, Cho Don District, Vietnam.

6.4 Study Methodology

The study began by a brief desk research to study the relevant domestic and international information available and by visiting the forestry sector related institutions around Hanoi for collection of background information and familiarising the consultancy team for forestry harvesting and wood and non-wood processing technologies applied in Northern Vietnam. Visits were organised to Forest Science Institute of Vietnam, plywood manufacturing companies, small scale sawmills, wood further processing companies, forestry and wood processing machine manufacturers, forestry tool and equipment manufacturers, bamboo mat and handicraft villages and Hanoi exhibition on Industrial Products.
The preliminary results of the ongoing market study form the basic ground for the requirements of technologies to be applied in the forestry and wood and non-wood processing sectors.

The study continued with field activities in Thai Nguyen town and Cho Don District to collect background information on existing applied technologies in the pilot villages and to familiarise consultancy team for the pilot village conditions and requirements on the forestry and wood processing technologies.

A training need analysis of the pilot village people on the applied technologies in forestry and wood and non-wood processing technologies was implemented and results combined in the final study report. The analysis was necessary to carry out in order to identify the level of know-how and skills, of the target groups, on the technologies to be introduced to the pilot villages as well as to be able to recommend development activities on a curriculum development, human resources development (training of trainers and extensionists) and on the development of appropriate training and extension programmes for the training of pilot village people.

Places visited during the mission are in Annex 13.

Analysis on the collected materials is summarised in the final study report on appropriate processing technologies to be applied in the pilot villages. Also in the study report the needed inputs for the implementation of the appropriate processing technologies for wood and non-wood processing have been analysed, identified and prioritised.

7. CHOICE OF APPROPRIATE TECHNOLOGIES

7.1 General Requirements in Applying Appropriate Processing Technologies

In applying of appropriate processing technologies there are certain conditions and requirements to be met in order to apply technologies efficiently and to achieve the best possible results of operations. The following factors should be well considered to enable effective wood and non-wood processing operations:

- Forest management operations have to be implemented by considering the sustainable forest management principles
- Operations must be implemented by considering the environmental aspects and their contribution to the welfare of rural people
- Availability of reliable forest inventories at the time of planning, the utilisation of forest resource and processing technologies

7.2 Harvesting Technologies in Wood and Non-Wood Materials

Highly mechanised, capital-intensive harvesting systems do not allow participation of rural people who live within or in the vicinity of the forest. It is thus important to introduce small scale forest harvesting systems that rely on basic or intermediate technology.

Non-wood forest products such as bamboo and rattan can also have an economic value for rural people.
One of the objectives of this study is to investigate small scale forest harvesting operations; to develop production standards and to recommend improvements in work phases and tools. It is hoped that the case studies during the Programme period will prove the technologies useful for Vietnamese conditions.

When speaking about technology, we usually mean tools, machines, techniques, and methods. Broadly it may be understood as a combination of knowledge, skills, organisation, equipment, and machines.

Forest technology may be traditional, basic, intermediate, or highly advanced. Each of them may be appropriate for certain conditions. Appropriate technology is the one which is suitable for locally prevailing economic, social and environmental conditions. Therefore, appropriate logging techniques should minimize costs, as well as environmental impacts.

Appropriate technology is based on qualitative and quantitative needs of production and employment, and on availability of energy and human skill. It must be applied according to the requirements of ergonomics, occupational safety and health, and national legislation.

In Cho Don district manpower for forest harvesting operations is easily available and labour costs are moderate. Therefore, it is encouraged to use labour-intensive instead of machine-intensive technology. This way employment opportunities for the pilot village people can be created.

When using manual labour and employing draught animals, less technical skill and training are needed. In most cases it appears that labour-intensive methods also have less harmful impacts on the environment.

The factors like location of the logging area, terrain and soil conditions, stand density, hauling conditions, availability and costs of manpower, financial possibilities and location of the forest areas from the pilot villages do support in choosing of the labour-intensive forest harvesting techniques for the pilot village areas.

In technology choice an important factor is also quantity of wood waste. Usually a main reason for waste is lack of skill and knowledge (e.g. high stamps and unappropriate cross-cutting and tree felling by axes instead of use of a bowsaw or cross-cut saws).

7.3 Processing Technologies in Wood and Non-Wood Products

Appropriate processing technology refers to a production system which is suitable for the particular environment where it operates. The dimensions of this environment are, on one hand, related to the necessary elements of the operation such as inputs, outputs and technology, and their interrelationships, and on the other hand, the economic, social, institutional and ecological impacts of the activity.

It is important to note that appropriateness is to be considered, from the given group of people facing the particular situation, not only with regard to economic circumstances and available resources but also to value priorities.

Appropriate technology is often associated with small scale production, labour intensity, low product quality, rural-based operations, the use of second hand and locally manufactured machinery, etc. versus the application of modern and advanced techniques.

Technology is truly appropriate if it can provide long-term benefits to the largest possible number of people and develop and expand its activities.
Development of the technologies should begin from the primary technologies in order to built up firm foundation for the further development of the sector.

The above factors should be well considered in the development and selection of the processing technologies into the pilot villages, due to the fact that the existing level of technologies, knowledge and skills of people and availability of raw materials are limited.

Manufacturing - the transformation of raw materials into industrial and consumer products - is an area in which there are many opportunities for increased economic activity.

8. PROBLEM ANALYSIS

During the field survey the consultancy team carried out problem analyses on the existing forest management practices and wood and non-wood processing technologies in the pilot villages and in some other areas of Cho Don district. The following are the main problem areas within the pilot villages:

- The attitude among the pilot village people towards conservation, reforestation and utilisation of forest resources is inadequate leading to over exploitation and utilisation of the existing forest resources

- Lack of awareness of importance of forest resources and it's utilisation in rural development and income generation as whole

- Lack of know-how and skills in forest management practices

- Lack of know-how and skills in wood and non-wood processing technologies

- Generally low working motivation due to heavy forest works

Example on income generation/year of a family in Ban Chang village:

<table>
<thead>
<tr>
<th>Product</th>
<th>Quantity/Year</th>
<th>Unit price (VN dong)</th>
<th>Income/Year (VN dong)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agriculture income</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td>1.000kg</td>
<td>1.500</td>
<td>1.500.000</td>
<td>20,3</td>
</tr>
<tr>
<td>Pork meet</td>
<td>100kg</td>
<td>10.000</td>
<td>1.000.000</td>
<td>13,5</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td></td>
<td><strong>2.500.000</strong></td>
<td><strong>33,8</strong></td>
</tr>
<tr>
<td><strong>Forest products income</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuelwood</td>
<td>18m³</td>
<td>80.000</td>
<td>1.440.000</td>
<td>19,5</td>
</tr>
<tr>
<td>Round wood</td>
<td>10m³</td>
<td>250.000</td>
<td>2.500.000</td>
<td>33,8</td>
</tr>
<tr>
<td>Bamboo shoot</td>
<td>30kg</td>
<td>15.000</td>
<td>450.000</td>
<td>6,1</td>
</tr>
<tr>
<td>Non-wood products</td>
<td></td>
<td>500.000</td>
<td></td>
<td>6,8</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td></td>
<td><strong>4.890.000</strong></td>
<td><strong>66,2</strong></td>
</tr>
</tbody>
</table>
As the above example shows the income generated from the forest products is about 66.2% from the total income generated from agriculture and forest products per year. The generated income of forest products is only from the round wood instead of processed wood products. If processing of round wood into wood products will take place the income of the forest products could be even more than it is in the example. Therefore the role of forest wood and non-wood products as income source for the forest users/farmer is remarkable and should be well considered in the development of pilot villages.

9. STUDY RESULTS

9.1 Present Situation in the Villages

9.1.1 Rawmaterial Resources

Wood and non-wood rawmaterial resources in the pilot villages are not well known and therefore inventories at availability of species, quantities and locations of rawmaterials should be carried out in order to improve planning of wood and non-wood processing technologies and activities.

9.1.2 Employment of Pilot Village People

Employment of rural people in processing of wood and non-wood products is low due to the fact that technologies do not exist in large scale and only little of pitsawing, forest harvesting and material transportation need labourforce.

9.1.3 Fuelwood Demand and Use

Demand and use of fuelwood is very high. There are about 776 households in the Dong Lac and Ngoc Phai communes consuming about average of 18m$^3$/year/house = 13,968m$^3$ of fuelwood per year, (min-max = 10m$^3$ - 24m$^3$/year/house), therefore cutting, collection, transportation and fuelwood making is one of the major work done by the rural people. In most cases women are collecting and making fuelwood for the daily use of the household. Big quantities of suitable rawmaterial for processing of wood products (big diameter and volume) is used for fuelwood making instead of processing them into marketable forest products. Use of small diameter fuelwood such as branches, young trees and wood waste suitable for burning are not efficiently used by the households due to the traditions and less demanding work required in using of the bigger size of fuelwood.

During the pitsawing operations in the forest also a lot of waste is produced, that waste is very often left into the forest and not even used as woodfuel or secondary construction material in the households.

9.1.4 Legislation

One of the main problems in procurement, selling and processing of wood is low use of legal rawmaterials. In land allocation process farmers have received principally poor forest
which do not have good timber. But in fact forest legislation problem has to note also on how to use, process and sell the forest resources without causing over exploration of forest resources.

9.1.5 Utilization of Rawmaterials in Harvesting and Processing Activities

Recovery of rawmaterials during the harvesting and processing activities is low and volume of waste left into the forest and produced by the millers is high due to the fact that there is a lack of know-how and skills in forest harvesting and wood processing operations.

9.1.6 Efficiency of the Operations

Efficiency of forestry operations is poor, because in every activity there are too many people involved. It is a fact that labourforce is abundant and cheap, but does not mean that it can be used unlimited and without any affects to the profitability of operations.

9.2 Existing Technologies

9.2.1 Harvesting of Wood and Non-Wood Rawmaterials

Wood harvesting operations in the pilot villages are mainly concentrating in the secondary natural forest from where the rawmaterial is sold to the sawmills and plywood manufacturing companies mainly in Thai Nguyen and Hanoi and very little of rawmaterial is processed in the villages. Tree felling, debranching and cross-cutting is manually made by the locally manufactured axes, wooden framed bow saws, knives and sometimes two-man cross-cut saws.

Non-wood materials such as bamboo and rattan are harvested manually by locally manufactured knives and wooden framed bow saws. Other non-wood products were not found harvested, collected or recovered due to the fact that their use has not been recognised by the farmers.

9.2.2 Extraction and Transportation of Rawmaterial and Products

Extraction of round wood, bamboo and rattan from the forest to the road side is made manually by pulling and carrying. No other more advance technologies were found in use. Transport from the road side to manufactures, dealers and customers is made by local trucks and tractors with rather low capacity and efficiency.

9.2.3 Wood Processing

In wood processing very basic processing technologies are used for converting wood into sawn timber to be used for different type of construction purposes. In many cases sawn timber is processed in the forest with pitsawing method and only ready made sawn timber is manually transported to the road side and again to the dealers and customers.

In the village level processing of wood products is almost zero apart from manual chipping of timber boards by axes and except processing of sawn timber with few locally manufactured circular saw bences. Small scale furniture manufacturing is made in the houses by the contractors from the other districts. All the processed wood products are used in the village level and no commercial production activities were found at the time of study.
The most common and most efficiently used sawing method in Vietnam is horizontal band sawing. Also most of the sawmill machinery found during the study were horizontal band saws. The existing machines are locally manufactured, simple to use and manually operated, which indeed for the existing conditions, know-how and skills is the best possible solution at time being. Maintenance, service, band saw blades and spare parts are locally available. The investment costs of one unit are still in the reasonable level. The operation of the machine can be done either by electric motor or separate power unit, which allows flexibility in the operations. Excellent and the most recommendable machine for the Vietnamese conditions. Circular and framesawing methods are also used in some extent, but not so commonly as bandsawing, therefore the processing technology is not so appropriate to Vietnamese conditions.

9.2.4 Non-Wood Product Processing

From non-wood materials only bamboo is processed mainly for the local construction, household and irrigation purposes. In the district only one factory is processing bamboo products, that is a chopsticks manufacturing mill at Bang Lung town, which is the only commercial unit using and selling bamboo products. In the village level bamboo was used as building material for flooring, walling, fencing etc.. The processing technology is very simple, whereby manual cutting, splitting and opening of the bamboo is made and product used as a mat or board. Some households were making bamboo baskets and other household items and handicrafts for their own uses. No other further processing technologies were used in processing of bamboo or any other non-wood products.

9.2.5 Fuelwood Making

Fuelwood making is mostly carried out manually with locally manufactured handtools, such as knives, axes and wooden and metal wedges. Sometimes cross-cutting of bigger diameter logs were done with wooden framed bow saws and two-man cross-cut saws. Transportation of small amounts and smaller size of fuelwood for the household uses were implemented by carrying them all the way from forest to home. Bigger ones were manually carried or pulled out from forest to the road side, where they were piled and later on transported with local trucks or tractors to homes, consumers or customers.

9.2.6 Maintenance of Tools and Equipment Used in Forest Harvesting and Wood and Non-Wood Processing Operations

Tools and equipment were maintained with a satisfactory level where the locally manufactured axes and knives were concerned but maintenance of the saws used for pitsawing, cross-cutting and sometimes for felling of trees were not well done due to the lack of knowledge and skills in maintenance of saws. The fact that the saws were not well maintained and appropriate has reduced their use in forest harvesting and fuelwood operations causing increased use of raw materials and increased quantity of waste due to the extra cutting allowance needed in use of axes and knives instead of using less waste producing methods such as bow saws and one and two-man crosscut saws. Generally all the maintenance activities and methods used in maintenance of tools and equipment should be strengthened and accordingly appropriate training and extension programmes should be established for the training of the people concerned.

9.3 Training Needs and Opportunities for the Village People

At the moment there is no training available for the forest users and farmers although it is
evidently very much needed. During the study it was observed that within the target group the level of information, knowledge and skills on forest harvesting and wood processing operations is rather low. Because of lack of information, training and extension, most of the carried out forest harvesting, woodfuel and wood processing activities are inefficient, uneconomical and do not follow the criteria's of sustainable forest management. Also in wood and non-wood processing technologies the similar trend can be seen.

10. DESCRIPTION OF THE TECHNOLOGIES TO BE APPLIED IN FOREST HARVESTING OPERATIONS

The following paragraphs are defining the possible solutions for forest harvesting operations to be applied and introduced in the pilot villages and in Cho Don district as whole. Some of the recommendations and ideas are only explained and introduced as processing alternatives but before applying them more detailed research should be implemented in order to find out the best possible solutions, techniques and methods.

10.1 Tree Felling and Debranching

Tree felling and debranching should be implemented by appropriate handtools for forest harvesting operations in Vietnam. Appropriate manual working techniques and forest harvesting methods should be introduced to fit into the local conditions in order to minimise quantity of wood waste, to maximise the volume of rawmaterial and to meet the rawmaterial requirements to be used for wood processing and fuelwood purposes. Appropriate cutting tools for tree felling are bow saws or one and two man cross-cut saws. Axes and forestry knives (machetes) should only be used for delimming and making of a felling sink during the tree felling. Appropriate wooden or metal wedges should be used during the felling operations to enable directed and controlled felling of trees. Also felling levers, felling tongs, sulkies and felling benches should be used as extra helping devices during the tree felling and debranching. (See annex 3).

10.2 Cross-cutting

Cross-cutting of the stems into suitable high quality logs and rawmaterial for wood processing purposes should only be processed either with bowsaws or one and two man cross-cut saws, in order to minimise wood waste as compared to the use of axes or forestry knives in cross-cutting. During cross-cutting operations several auxiliary devices, such as log tongs, log picks, pulpwood hooks and cant hooks, should be used for improvement of logging productivity and to make working procedures easier, lighter and safe. (See annex 4).

10.3 Procedures and Working Techniques in Log Making for Wood Processing and Fuelwood

In log making and fuelwood preparation the priorities should always be in high rawmaterial recovery. That objective can be achieved by minimising the wood waste by using the appropriate tools for cross-cutting and by producing good and high quality round wood rawmaterial for wood processing operations. All suitable round wood logs should be processed into wood products instead of using them for fuelwood purposes. By doing so the value of forest products and income from the forest as whole can be increased. While processing and recovering the best rawmaterials by processing them into marketable high value wood products also a lot of other wood/forest materials will be processed to be used as fuelwood. These other materials for fuelwood could be small diameter trees from the
thinnings and harvesting operations, tree branches from felling of the commercial round wood, sawing rejects such as offcuts, slabs, bark etc.

When doing felling and cross-cutting of the trees a lot of emphases should be put towards correct working techniques, bucking of stems (cross-cutting) and recovering of the valuable rawmaterials, this is because a big portion of high value rawmaterial can be destroyed if the right working techniques and procedures have not been followed. (See annex 5 & 6).

11. DESCRIPTION OF THE TECHNOLOGIES TO BE APPLIED IN EXTRACTION AND TRANSPORTATION OF WOOD, FUELWOOD AND NON-WOOD RAWMATERIALS AND PRODUCTS

When the land allocation was executed and some of the demonstration areas identified the boundaries of the plots were mainly opened in straight lines going in the vertical direction from the bottom of the mountain to the top. Therefore, it is highly recommended that these boundaries should be used for the transport and moving purposes whenever some activities are implemented in the plots. Also the advantage of that practice is that the boundary lines will be kept clean, the environmental impacts to the forest will be much lower and in a long run the boundaries can be developed as access roads to the forest areas, which can be developed to the size of the forest requirements.

Most of the transport methods and applications, explained below, can be efficiently used for wood and non-wood rawmaterials, products as well as for fuelwood transportation. Therefore, different transport methods for fuelwood, wood and non-wood materials have not been separated in the study report, but defined as uniform means to be applied for any materials in certain conditions. In applying and using of the transport methods, some adjustments of the method may be necessary in order to use it efficiently.

11.1 Manual Transport Means

During the harvesting, extraction and transportation of rawmaterials carrying of wood is often necessary, but it should be kept in the minimum and instead wheels should be used. For lifting and carrying of materials auxiliary devices (log tongs, log picks, log hooks and pole tongs) should be used to make lifting and carrying easier and lighter. Manual wood material moving should be avoided as much as possible because of accident risks in poor terrain conditions. If any materials are to be moved manually possibilities of using gravity and rolling of logs should be done.

In preparation of fuelwood and similar shortwood has sometimes to be carried for longer distances, even kilometres. Then different methods can be used. The preferred methods are to use a shoulder harness, carrying woodfuel on the back, using headstraps shoulder poles or using back frames. (See annex 7). If large size of logs are to be moved shoulder yokes (several men) with loops around the log can be used. (See annex 7).

11.2 Gravity Sliding

Logs can also be moved manually downhill by letting them slide on the ground, using simple aids. The force of gravity can be controlled by letting the logs slide in log chutes. The log chutes can be made of wood or plastic. Small logs or short pieces of wood can be moved downhill on slopes with a gradient of 25% or more for distances of up to 300-400m. Plastic chutes are commercially available in different sizes. (See annex 8).
11.3 Wheeled Transport Means

A wheeled vehicle enables loads to be moved more efficiently than is possible with a manual carrying aid and indeed they are essential when more than 50kg has to be transported by one person. These devices are suitable for carrying loads on flat or gently sloping terrain but not on steep Gradients. The simplest and cheapest types of hand-propelled vehicles are wheelbarrows and handcarts.

Several wheelbarrow and handcart designs (one or two wheel) can be manufactured of wood or metal to be used in different type of material transport (woodfuel, sawn timber logs etc.). (See annex 9).

Bicycles can also be used to transport fuelwood and other smaller and lighter size of wood and non-wood materials and they can also be equipped with some accessories such as baskets, sidecar, trailers and platforms to enable better efficiency. (See annex 10)

11.4 Sulky Transport

The manual log arch, or sulky, has been developed as an intermediate level forestry tool to combine low investment and running costs with an efficient log forwarding capability. With sulky loads up to 400kg can be transported - single logs or bunches of smaller logs and fuelwood can be forwarded completely off the ground, or long poles can be skidded with an end on the ground. The sulky is operated by manpower alone or used in combination with draught animals.

H-frame sulky is the most common design of the sulky. The bogie axle type is more difficult to manufacture but is more efficient in use. The two wheel type is easier to manufacture but heavier to pull and use. Any of these two type of sunkies can be locally manufactured.

Sulky can be used in various terrain conditions and the most efficient ones are the gravity sunkies used in steep terrain. The two sunkies are connected on either end of a wire rope and as one sulky moves downhill the other moves uphill. Unloaded sulky acts as a brake for the loaded one in downhill logging or as a pulling force in uphill logging. (See annex 11).

Sulkies can be also used on the roads for transport of different materials and for moving fuelwood and logs processed from the garden areas.

Sulky can be also used for moving of non-wood materials such as bamboo and rattan.

11.5 Transport by Buffaloes

Buffaloes are used very efficiently, as draught animals, in extracting and transporting the raw materials particularly form the forest to the road side, but can also be used for transport of raw materials for a longer distances from the road side to the possible manufacturing places in the villages. It is for wet terrain and can be easily trained.

For skidding of logs in the forest the buffaloes can be equipped with different types of yokes to enable pulling of rather big loads. In some cases even two buffaloes can be used for extraction of the bigger logs.

This method is very successfully also used in Cho Don district, but some further development of the method should be carried out in order to get the best possible use of them.
A wide range of skidding equipment is available for terrain transport with animal traction. Some of the most common ones are as follows (See annex 12):

- Skidding chains, attached to the log to be skidded, are the most simple means and are commonly used
- Skidding tongs and grapples, are also often used particularly when the log end easily snags or digs into the soil
- Several skidding pans, also called sledges, are used in animal skidding to reduce friction and to make sliding easier. The pans can be locally made of fibreglass or metal.
- Also bunk sledges of several kind can be used for skidding of rawmaterials
- For animal skidding their are several applications to be applied in the pilot villages as long as the buffaloes will be used for skidding operations

The animal-drawn two and four wheeled trailers can also be used for transport of rawmaterials and products for a longer distances. The development of these equipment should be introduced into the pilot villages.

11.6 Cable Yarding

At present one cable yarding system is been used by the mining people for carrying stones down from the mountains. The cable system is locally manufactured and seems to be working well. If the existing system can be developed it can be introduced and applied for transport of wood and non-wood rawmaterials and products.

A demonstration cable yarding system should be established into one of the pilot villages to be as an example for others.

11.7 Transport by Trucks

Local trucks should only be used for long distance transportation.

11.8 Loading and Off-loading Techniques

Techniques and methods for handling, loading and off-loading of materials should be developed and introduced. Particularly loading and off-loading of big and heavy logs can be improved and made more efficient and easier.

12. DESCRIPTION OF THE TECHNOLOGIES TO BE APPLIED IN WOOD PROCESSING

12.1 Pitsawing Operations and Maintenance of Saws and Tools

At present pitsawing is very widely used and is almost the only method of processing sawn timber in the pilot villages. The present technology is mainly concentrating on horizontal sawing method whereby the logs are lying on a vertical position and sawing is done by two men from the both side of the log. In some cases very short and small, high value indigenous wood species, were produced instead of processing bigger dimension sawn
timber. Reasons for the size, quality, value and utilisation of the indigenous raw material are several. Main reasons are the following:

- Indigenous hardwood species will bring better income for the processor
- Wood is more recognised by the further processors and customers
- Transport of heavy material is easier when the size of the log is small
- Source of the raw material is not well known and therefore safe to use

The following is recommended for pitsawing operations in the pilot villages:

- All suitable round wood for processing of sawn timber and wood products should be used for the income generation rather than for fuel wood purposes as done at the moment.
- Pitsawing method should be developed also to include vertical sawing operations whereby the workers will use less energy and at the same time an efficiency of the operations will be improved.
- Introduction of a new pitsaw design should be done in order to improve the operations.
- Maintenance and development of the existing cutting and auxiliary tools including axes, knives, log holders and saws should be implemented in order to make work more efficient and productive.
- Introduction of new working methods should be done.
- Training of the pitsawyers on processing methods, working techniques and maintenance of the tools should take place as soon as possible

12.2 Sawing Operations

At present mechanised sawing operations do not exist at the pilot village level and therefore all the following aspects discussed under the different sawing operations are the recommendations of the consultant team for a development of wood processing technologies into the village levels and communes as whole. The recommendations should be considered by the project administration and possibly a feasibility study on the profitability and appropriateness should be carried out.

12.2.1 Chainsaw Technology

Chainsaw technology is not used in the pilot villages either in forest harvesting or in wood processing. Although the chainsaws can be used in both operations to improve and develop the existing methods and productivity, it is not recommended due to the facts on availability of maintenance, spare parts and cost effectiveness. Also, the chainsaw used in the wood processing operations as a second phase of sawing operations is not recommended, because the volume of waste produced as compared to the bandsaw is very big. For sawn timber processing there are better technologies available rather than use
of the chainsaws.

Chainsaws can be used for harvesting operations as soon as the problem areas have been solved and they will not affect its operations and use.

12.2.2 Circular Sawing

Circular saws can be used in different type of operations like in wood processing, wood further processing (furniture) and in fuelwood preparation.

It is recommended that small size of circular saw tables should be used as a dimension saw in the furniture manufacturing. (Already used in some bigger places, but not in the villages)

The second use of the circular saw could be as a mobile double edger with the horizontal bandsaw unit to be used for the edging of sawn timber. Because with the bandsaw unit, board edging can not be done, and therefore board edger is necessary equipment with the bandsaw. At the same time the circular saw unit could be used as a resaw unit for smaller size of timber, as long as the construction of the bench is made according to those requirements. In this case the unit should be equipped with power pack and with appropriate size of a saw blade for the resawing purposes. The same unit will also be as a demonstration unit of the circular saw techniques.

The third alternative for the use of a circular saw is to use it with a special constructed cross-cutting and splitting machine for fuelwood preparation, which indeed is very much needed in the pilot villages. The machine should include two main components, one for cross-cutting with a circular saw and the other one as spiral for splitting of the fuelwood. The machine can be locally manufactured and should be constructed on the frame of the local tractor or truck to enable power supply from the main unit and to use it as a mobile fuelwood making machine. This could be a good business opportunity for a farmer or forest owner to start contracting of fuelwood making. Possibilities in manufacturing of the machine should be studied and alternatives for the initial investment opportunities for a forest owner should be researched.

12.2.3 Band Sawing

Circular, horizontal frame- and bandsawing methods are used in the other areas of Cho Don district and Vietnam as whole. As a result of the study it's highly recommended that if any mechanised sawn timber processing technologies are to be introduced it should be bandsaw technology due to the fact that all the advantages of bandsaw technology, local conditions, availability of maintenance, spare parts, know-how and skills are supporting the selection of bandsaw technology to be the most suitable technology.

It is highly recommended, if an investment or purchase of a bandsaw unit will take place in the project or if their will be a farmer to be supported through the loan systems, that co-operation between the manufactures of the bandsaw machines and the local machine buyer will be arranged to make arrangements and agreement for supplying a mobile horizontal bandsaw unit. This unit/owner of the mill could operate as a sawmill contractor, who can move with the sawmill around the commune and process the available rawmaterial of the forest owners into valuable wood products to be used locally or sold for the markets.

It is also recommended, that a possibility of manufacturing a local manufactured mobile handsaw unit could be checked out. If the local manufacturers are able to make one unit the Programme should also consider of purchasing a demonstration sawmill unit to be used in one of the villages.
If any advise is needed in manufacturing of the local bandsaw unit, it could be combined to the second phase of the appropriate technology consultancy in Vietnam.

12.3 Veneer and Panels Production

At present processing of wood panels such as plywood, particleboard and veneer do not exist in the pilot villages. In Vietnam the processing technologies are still very primitive and labour intensive, although the needs of the panel products is high in construction and furniture manufacturing, it is not recommended to introduce this technology at the moment, but in the future. It is much better to begin with the primary wood processing activities such as sawing and furniture manufacturing rather than to start from too high technology.

12.4 Ice-cream Stick Production

In wood processing one good possibility of processing the small diameter wood is to begin ice-cream stick manufacturing with the locally manufactured machines. The machines can be manufactured in Hanoi and do not need big investments. Training of the personnel can be done locally by the local consultants. This processing technology will utilise the small diameter rawmaterials and will improve the forest utilisation as whole. Good exercise to be developed and implemented.

12.5 Furniture Manufacturing

At present their are very few people who are specialising in furniture making in the pilot villages, but some of the furniture makers were found in the villages from the other areas. The demand of furniture is high and therefore it is recommended that furniture making at the pilot village level should begin. To begin the activities a training programme should be established for training of few carpenters for the pilot villages. Technology to be used at the beginning of the Programme should be labour intensive, handtool oriented, simple in processing techniques (manual) and favouring utilisation of local rawmaterials. Training can be arranged, after establishing the appropriate training curriculum and programmes, by the local experienced furniture makers and vocational training teachers from the vocational training centres.

Development and maintenance of handtools, workshop arrangements, occupational safety, working methods, product designs and maintenance of tools and knives should be included into the training programmes and to the on-the-job training activities.

Development of this sector is highly recommended due to the good impacts to the village level in many aspects.

12.6 Fuelwood Preparation

In daily life, the fuelwood collection and making, is one of the biggest activity of the pilot village people and more or less the only use of forest resources. Collection and making of fuelwood is manually done with very basic handtools and carrying of the materials every
day from the forest. Therefore, it is recommended that development and improvement in fuelwood collection and making should have a big priority in the beginning of the Programme. In order to reach reasonable utilization of forest resources in the wood processing activities, it is important to begin extension activities in use of forest resources and particularly in increasing the awareness and information about the utilisation of wood materials for wood processing and fuelwood purposes.

12.6.1 Cross-cutting and Splitting

It is recommended that fuelwood collection and making should be improved and developed. Appropriate tools for manual fuelwood preparations should be introduced in order to minimise wood waste during the cross-cutting and splitting. Use, maintenance and development of proper cross-cut saws, splitting axes and wedges for fuelwood making should be introduced and demonstrated respectively.

Development of a mechanised and mobilised fuelwood making machine, as explained in the chapter 11.2.2, should be studied. If applicable to the pilot villages and Cho Don district conditions, a local manufacture should be found to modify a demonstration machine for the project demonstration purposes.

12.6.2 Transport

For transport of fuelwood, see chapter 11. Same technologies can be applied for transport of fuelwood although some adjustments will be needed.

13. TECHNOLOGIES TO BE APPLIED IN NON-WOOD PROCESSING AND TRANSPORTATION

13.1 Bamboo and Rattan Harvesting and Transportation

Felling of bamboo and rattan can be implemented with the traditional way as it has been carried out. The development of appropriate tools for felling and especially for cross-cutting should be developed, which at present is made by the knives instead of saws. Special saws for cross-cutting and felling could be developed. Further development of extraction and transport technologies should be carried out in order to make transport more efficient, easier and applicable to the prevailing forest conditions.

For transport of bamboo and rattan, see chapter 11, Same technologies can be applied for transport of bamboo and rattan although some adjustments will be needed.

13.2 Bamboo Processing

At present bamboo is processed only for the local household purposes as explained in the study results. Some new processing technologies can be recommended for further processing of new bamboo products such as bamboo mats, boards, corrugated roofing materials and handicrafts.

The consultancy team recommends, that more detailed research work should be carried out on processing new bamboo products like veneer and roofing materials.

As soon as, the feasibility on processing of the veneer and roofing sheets can be shown, the new processing technologies should be introduced into Cho Don district and the pilot
Meanwhile, other available and already elsewhere used bamboo processing technologies should be introduced into the pilot villages. Mainly they can be of processing bamboo mats, laminated bamboo boards and particularly handicrafts made out of bamboo.

In establishing new processing facilities and in applying new processing technologies local consultants should be used for advise, consultancies and for training of personnel to perform the new processing techniques.

In processing and designing of handicraft products their are already some very good local people to train some key persons in working techniques and methods, whom should be used as much as possible in transferring the knowledge and skills.

13.3 Rattan Processing

Rattan can be used as rawmaterial for handicrafts production. The local experienced consultants should be used as indicated and explained in processing of bamboo products.

13.4 Other Non-wood Product Processing

Development and identification of new processing technologies for processing of non-wood products should follow the recommendation of the implemented market study.

14. TOOLS, EQUIPMENT AND MACHINERY DEVELOPMENT FOR THE TECHNOLOGIES TO BE APPLIED IN THE PILOT VILLAGES

One important aspect of processing technology is development of new technologies, working techniques, machinery, equipment and tools as well as improvement of the existing ones.

In Cho Don district and particularly in Ban Chang village there are few blacksmith's workshops and machine manufactures who can be well used in the development and improvement of the new and existing technologies. Within the Programme one of the key area should also be the development of machinery, equipment and tools suitable for the pilot village conditions and Cho Don district as whole.

If the proposed forest harvesting and wood and non-wood processing technologies will be developed, introduced and applied, it will be necessary to make either local manufacturing or purchasing, or in some cases importing of the appropriate machinery, equipment and tools for the successful implementation of the Programme.

It is also recommended that some of the most important items should be purchased as examples and demonstration objects.

These machinery, equipment and tools are also needed when implementing training and extension programmes for the farmers and forest owners.

The following is the list of machinery, equipment and tools to be developed, manufactured or purchased under the development of the appropriate wood and non-wood processing technologies to be applied in the pilot villages.
14.1 Forest Harvesting Operations

- One-man bow saws, different types
- Two-man cross-cut saws, different types
- Axes, splitting & dilimbing
- Debarking knife & spud
- Turning hooks & sappies
- Log tongs & picks & jacks
- Cant and hand hooks
- Wedges for different uses
- Maintenance tools and equipment
- Carrying and loading hooks
- Felling levers, tongs
- Maintenance tools and equipment for handtools

14.2 Transportation of Rawmaterials and Products

- Backracks
- Different type of yokes
- Different type of wheelbarrows & handcarts &
- Skidding tongs & cones & sleds & cradles & sledges etc.
- Skyline equipment
- Different type of sulkies
- Animal-drawn trailers
- Equipment for gravity solutions in wood transport
- Metal or fibreglass chutes
- Different type of equipment and accessories for animal transport of materials

14.3 Wood Processing

- Pitsawing equipment and saws
- Development of a simple locally manufactured mobile board edger circular saws
• Development of a locally manufactured mobile bandsaw unit
• Ice-cream stick manufacturing machinery, pilling machine, cross-cut saw, punching machine, sanding machine, dryer

14.4 Non-wood Processing Operations
• Handtools for processing of handicrafts
• Harvesting knives and saws
• Transport equipment as shown in the chapter 14.2

14.5 Furniture Making
• Development of working places/workshops/work benches
• Development of handtools
• Equipment and machinery for simple furniture manufacturing

14.6 Maintenance of Tools and Equipment
• Development of maintenance tools and equipment for maintenance of forest harvesting, wood and non-wood processing tools and knives

14.7 Fuelwood Preparation
• Firewood cutting and splitting
• Tools and equipment as in the chapter 14.1 & 14.2

15. TRAINING AND EXTENSION ACTIVITIES

15.1 Training
In improvement and development of the wood and non-wood processing technologies the key aspect of the success is to develop and implement appropriate training and extension programmes. These training programmes will enable the rural people to adapt necessary knowledge, skills and information for the execution of appropriate processing technologies to be applied.

The consultancy team recommends the following approach in the development and implementation of the training activities. The training activities have been divided into immediate and long term training activities:

Immediate activities:

• Development of an appropriate training curriculum for the training of trainers and extensionists to be used in training of pilot village people in forestry, wood and non-wood processing technologies and in any other related areas
• Establishment of co-operation between Trainers/Extensionists of the Programme and the existing training institutions in forestry and wood processing

• Training of trainers and extensionists in pedagogics and teaching methods

• Training of trainers and extensionists in the technical issues and in the field of their expertise

• Training of trainers and extensionists in appropriate and sustainable forest management practices to be implemented in the pilot villages

• Arranging of a study visits for the key persons of the Programme to be familiarised with the processing technologies applied in the other areas of Vietnam

Long term activities:

• Development of training curriculum for training of the pilot village and rural people of Cho Don District in forestry and wood processing

• Development of further training programmes in forestry and wood processing technologies suitable for the pilot village people and Cho Don district as whole

• Implementation of extension and further training programmes

• Development of new training activities according to the needs of the target groups

• Development of training programmes on the new working methods and techniques to be applied in wood and non-wood processing

15.2 Extension

As a part of the appropriate processing technology an extension programme should be developed for training of farmers in appropriate processing technologies.

Awareness of wood rawmaterial utilisation, conservation of rawmaterial resources and principles of sustainable forest management should be included into the extension programmes to be implemented for the farmers.

Through the extension activities also practices on sustainable forest management should be shown for the farmers.

16. FINDINGS

The following are the findings and conclusions of the appropriate processing technology study:

• There is a lack of awareness about importance of forest resources and possibilities in utilization of it for the sustainable rural development as whole

• At the moment it seems that forest management practices have not been implemented by considering and following the sustainable forest management
principles due to the lack of knowledge and skills of the subject, which indeed is a major problem in planning, developing and implementing wood and non-wood processing activities.

- Availability of appropriate forest resources information based on inventories about wood and non-wood rawmaterial resources, available wood species, location of forest areas etc. is not adequate and accurate.

- At the moment agriculture is the main source of income for the households and farmers do not have good understanding about the forest resources and how to use them for better income generation, employment opportunities and as an alternative for agriculture activities.

- Attitude towards conservation, reforestation and utilization of forest resources is inadequate leading to over exploration and unsustainable use of the existing forest resources.

- Generally low working motivation among the rural people towards heavy and poorly paid forest work.

- From the total consumption of wood rawmaterial a portion of fuelwood is far too high as compared to the commercial use of rawmaterials, no accurate and concrete records were available for the research of rawmaterial utilization.

- People in the pilot villages use a lot of time and effort for the collection and preparation of their daily fuelwoods instead of organizing centratised fuelwood preparation, procurement and storing.

- There is a lack of know-how and skills in forestry harvesting and wood and non-wood processing operations.

- Labourforce at village level is abundant and a big advantage in the development of the forestry sector as whole, but possibilities to employ people in processing of wood and non-wood products is low.

- In the pilot villages, there is a high demand on appropriate training and extension services for the improvement of knowledge and skills of rural people.

- The level of existing technologies in forest harvesting operations and processing of wood and non-wood is low.

- Volume of waste, produced during the preparation of fuelwood and logs, is high due to the inappropriate working techniques and tools/equipment used in forest harvesting operations and in fuelwood preparation.

- In the pilot villages, their are some small scale wood processors, although development and improvement of the operations and small-scale wood processing sector as whole, should be implemented.

- Non-wood rawmaterials such as bamboo and rattan are very much existing, but processing of them is still very limited and should be developed in order to create better income and more employment.

- Other non-wood products such as fruits, mushrooms, essential oils, medical trees e.g.
are not processed due to the fact that people in the rural areas do not know the opportunities in growing, processing and selling of the non-wood products. Therefore extension work at village level should be carried out in order to create better understanding of the given opportunities in growing and processing of non-wood products.

- There is a need to carry out a research on possible marketable wood species which are not known at the moment and can bring some valuable rawmaterial for wood processing operations

- In Cho Don district manpower for forest harvesting operations is easily available and labour costs are moderate.

- Demand and use of fuelwood is high compared to the use of commercial wood and therefore a balance to this serious problem should be found through sustainable forest management practices.

- In wood processing very basic processing technologies are used for converting wood into sawn timber to be used for different type of construction purposes

- From non-wood materials only bamboo is processed mainly for the local construction, household and irrigation purposes

- At the moment there is no training available for the forest owners and farmers although it is evidently very much needed.

- In improvement and development of the wood and non-wood processing technologies the key aspect of the success is to develop and implement appropriate training and extension programmes

- Buffaloes are used very efficiently, as draught animals, in extracting and transporting the rawmaterials particularly form the forest to the road side, but can also be used for transport of rawmaterials for a longer distances from the road side to the possible manufacturing places in the villages. It is for wet terrain and can be easily trained.

- One important aspect of processing technology is development of new technologies, working techniques, machinery, equipment and tools as well as improvement of the existing ones.

17. RECOMMENDATIONS

The technology study results show quite clearly that in developing the existing wood and non-wood processing technologies their will be activities that should take place and begin immediately in order to develop and improve the living standard of rural people, increase income and employment opportunities at village level, decrease the deforestation, improve utilisation of rawmaterial resources and last but not least to secure sustainability of forest as whole.

The following activities are recommended:

- Improvement and development of reliable and sustainable forest management activities to support utilization of forest resources through appropriate processing
operations

- Introduction and development of appropriate manual working methods to be applied in forest harvesting and wood and non-wood processing activities. Establishment, development and implementation of extension and training programme for the training of farmers and rural people as whole.

- Improvement and development of hand tools for harvesting and fuelwood operations.

- Development of appropriate extraction and transport means and methods for wood and non-wood rawmaterials and products to be applied at village level.

- Training of rural people in appropriate use of fuelwood and preparation of suitable rawmaterials (logs) for commercial uses.

- Development of non-wood processing technologies to be applied in the villages. Development of simple and small scale wood processing technologies to be applied for utilising the small diameter wood rawmaterials.

- Improvement and development of use, collection, transport and making of firewood.

- Appropriate tools, equipment and machinery development for the small scale technologies to be applied in the pilot areas.

In order to achieve sustainable use of existing forest resources and continues development of processing technologies together with sustainable forest management practices it is highly recommended that the following development activities should be implemented in long term bases:

- Further development of more sophisticated wood processing technologies such as sawing operations, small scale veneer peeling and particleboard manufacturing, furniture manufacturing etc.

- Development of more mechanised wood harvesting and transport systems to be applied in thinning and regeneration operation as soon as the appropriate forest management practices are under the implementation.

- Establishment of credit systems for the investments in wood and non-wood processing technologies.

- Product and design development in further processing Of wood and non-wood products such as furniture, wood panels, bamboo corrugated roofing materials, bamboo boards, bamboo mats, handicrafts etc.

- Establishment of credit systems for the farmers to enable them for small investments while developing the forestry and wood processing sectors and establishing new employment opportunities and processing units to the pilot villagers.

**BIBLIOGRAPHY**


### Annex 1/1: Checklist of Non-Wood Forest Products in Vietnam

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<tr>
<th>Product</th>
<th>1986</th>
<th>1988</th>
<th>1990</th>
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<tbody>
<tr>
<td>1. Cinnamomum bark (tons)</td>
<td>1 520</td>
<td>1 080</td>
<td>2 100</td>
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<tr>
<td>2. Aloeswood (tons)</td>
<td>78.5</td>
<td>45.4</td>
<td>20.2</td>
</tr>
<tr>
<td>3. Anise essential oil (tons)</td>
<td>1 500</td>
<td>1 305</td>
<td>2 000</td>
</tr>
<tr>
<td>4. Tung seeds (tons)</td>
<td>1 378</td>
<td>4 082</td>
<td>n.a.</td>
</tr>
<tr>
<td>5. Tung oil (tons)</td>
<td>150</td>
<td>60</td>
<td>10</td>
</tr>
<tr>
<td>6. Castor seeds (tons)</td>
<td>250</td>
<td>210</td>
<td>230</td>
</tr>
<tr>
<td>7. Pine resin (tons)</td>
<td>2 400</td>
<td>2 560</td>
<td>2 500</td>
</tr>
<tr>
<td>8. Rosin (tons)</td>
<td>2 359</td>
<td>1 508</td>
<td>100</td>
</tr>
<tr>
<td>10. Canarium resin (tons)</td>
<td>58</td>
<td>153</td>
<td>n.a.</td>
</tr>
<tr>
<td>11. Yang oil (tons)</td>
<td>178</td>
<td>165</td>
<td>n.a.</td>
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<tr>
<td>12. Damar (tons)</td>
<td>213</td>
<td>375</td>
<td>132.7</td>
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<tr>
<td>13. Thick bamboo (million culms)</td>
<td>135.2</td>
<td>131.2</td>
<td>149.5</td>
</tr>
<tr>
<td>14. Thin bamboo (million culms)</td>
<td>179.0</td>
<td>177.1</td>
<td>n.a.</td>
</tr>
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<td>15. Decorative bamboo (million culms)</td>
<td>321.7</td>
<td>311.3</td>
<td>n.a.</td>
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<tr>
<td>16. Thick rattan (million meters)</td>
<td>7.7</td>
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<td>17. Thin rattan (million meters)</td>
<td>70.6</td>
<td>117.5</td>
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<td>18. A. tsao kwa (tons)</td>
<td>153</td>
<td>19</td>
<td>n.a.</td>
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<td>19. Amomum spp (tons)</td>
<td>103</td>
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<td>20. Polygonum (tons)</td>
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<td>21. Morinda (tons)</td>
<td>31</td>
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<tr>
<td>22. Other medicinal plants (tons)</td>
<td>3 303</td>
<td>3,691</td>
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<td>23. Mushrooms (tons)</td>
<td>108</td>
<td>134</td>
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<td>24. Jew’ ear mushroom (tons)</td>
<td>182</td>
<td>164</td>
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<tr>
<td>25. Fresh bamboo shoots (tons)</td>
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<td>26. Dried bamboo shoots (tons)</td>
<td>975</td>
<td>321</td>
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<tr>
<td>27. Chestnut (tons)</td>
<td>72</td>
<td>85</td>
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</table>
Annex 1/2: Vietnamese non-wood forest products according to end-use:

1. Extraction of essential oils
   - from roots and stumps: *Cupressus funebris, Dianella ensifolia, Fokienia hodgensii, Aquilaria crassna*
   - from fruits: *Litsea cubeba*
   - from leaves: mint, citronelia, ocinum, cajenut trees (?), *Eucalyptus citriodora*

2. Medicinal plants
   - fruit and/or seeds: *Amomum spp., Cassia tora*
   - flowers: *Sophora japonica*
   - bark: *Eucmonia ulmoides, Phellodendron anurence*
   - roots: *Morinda officinalis, Dioscorea persimilis*
   - leaves: *Artemisia annua*

3. Food crops
- turmeric, ginger, cashew nut, chestnuts and condiments, edible mushrooms
- wild honey
- pythons, monkeys, birds, deer, gecko

4. Resins and gums
   - *Toxicodendron succedanea, Liquidambar formosana, Canarium spp., Dipterocarpus alatus, Altingia takhtadjanii*

5. Dye and tannin
   - *Rhizophora indigofera*

6. Fibers
   - agave, *Ceiba pentantra, Rhaninoneuron balansea*

7. Fishing rods, furniture
   - bamboo and rattan

Annex 2: List of Contacts by Market Study Team

<table>
<thead>
<tr>
<th>No</th>
<th>Name</th>
<th>Company / Organisation</th>
<th>City</th>
<th>Date</th>
</tr>
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<tbody>
<tr>
<td>1.</td>
<td>Mr. Binh</td>
<td>Vice chairman of Cho Don district</td>
<td>Cho Don</td>
<td>3.10.96</td>
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<tr>
<td>2.</td>
<td>Mr. Loi</td>
<td>Chairman of Dong Lac commune</td>
<td>Cho Don</td>
<td>4.10.96</td>
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<tr>
<td>3.</td>
<td>Mr. Tu</td>
<td>Manager of Cho Don forest processing enterprise</td>
<td>Cho Don</td>
<td>5.10.96</td>
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<tr>
<td>4.</td>
<td>Mr. Thanh</td>
<td>Cho Don forest station</td>
<td>Cho Don</td>
<td>7.10.96</td>
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<tr>
<td>5.</td>
<td>Mr. Trieu Van Duong</td>
<td>Chairman of Ngoc Phai commune</td>
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<td>8.10.96</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Planning &amp; statistical division</td>
<td>Cho Don</td>
<td>8.10.96</td>
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<tr>
<td>7.</td>
<td>Mr. Ha Van Moc</td>
<td>Chairman of Phuong Vien commune</td>
<td>Cho Don</td>
<td>9.10.96</td>
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<tr>
<td>8.</td>
<td>Mr. Hoang Van Thung</td>
<td>Bang Lang commune</td>
<td>Cho Don</td>
<td>9.10.96</td>
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<tr>
<td>9.</td>
<td>Mr. Nguyen Tien Vung</td>
<td>Sawmill manager</td>
<td>Cho Don</td>
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<tr>
<td>10.</td>
<td>Mr. Le Quang Dan</td>
<td>Director of Bac Can forest processing enterprise</td>
<td>Bac Can</td>
<td>11.10.96</td>
</tr>
<tr>
<td>11.</td>
<td>Mr. Quy</td>
<td>Manager of sawmill of Bach</td>
<td>Bac Can</td>
<td>11.10.96</td>
</tr>
<tr>
<td>No.</td>
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<tr>
<td>12</td>
<td>Mr. Hung</td>
<td>Manager of plywood enterprise small scale</td>
<td>Bac Can</td>
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<tr>
<td>13</td>
<td>Mr. Thuy</td>
<td>Bac Thai department of agriculture and rural development</td>
<td>Thai Nguyen</td>
<td>11.10.96</td>
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<tr>
<td>14</td>
<td>Mr. Dinh Khac Hiep</td>
<td>Director of BacThai forest produce company</td>
<td>Thai Nguyen</td>
<td>2.10.96</td>
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<tr>
<td>15</td>
<td>Mr. Ly Van Trong</td>
<td>Associate Director, University of agriculture and forestry</td>
<td>Thai Nguyen</td>
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<td>Hoang Van Thu paper company</td>
<td>Thai Nguyen</td>
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<td>Bac Ha cooperative</td>
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<td>18</td>
<td>Mr. Hua Thu Quy</td>
<td>Votive paper company</td>
<td>Thai Nguyen</td>
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<tr>
<td>19</td>
<td>Mr. Duong Quoc Tuan</td>
<td>Hoang Binh enterprise</td>
<td>Thai Nguyen</td>
<td>15.10.96</td>
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<tr>
<td>20</td>
<td>Mr. Pham Trong Dan</td>
<td>Director of Dong Hy forestry farm</td>
<td>Thai Nguyen</td>
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<td>21</td>
<td>Mr. Thanh</td>
<td>Director of Phu Binh forestry farm</td>
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<td>22</td>
<td>Mr. Luu Xuan Hoa</td>
<td>Director of BacThai forestry station</td>
<td>Thai Nguyen</td>
<td>17.10.96</td>
</tr>
<tr>
<td>23</td>
<td>Mr. Quyet &amp; Mr. Hanh</td>
<td>Vice director of Statistical department Vice head of synthetic division</td>
<td>Thai Nguyen</td>
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<tr>
<td>24</td>
<td>Mr. Thinh</td>
<td>Dai Tu forestry farm</td>
<td>Thai Nguyen</td>
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<tr>
<td>25</td>
<td>Mr. Ha Chu Chu</td>
<td>Director of Forest Science Institute of VN</td>
<td>Ha Noi</td>
<td>22.10.96</td>
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<tr>
<td>26</td>
<td>Mr. Nguyen Duc Hong</td>
<td>Deputy general director of Essential oil enterprise</td>
<td>Ha Noi</td>
<td>23.10.96</td>
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<tr>
<td>27</td>
<td>Mr. Thong</td>
<td>Ministry of agriculture &amp; rural development</td>
<td>Ha Noi</td>
<td>23.10.96</td>
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<tr>
<td>28</td>
<td>Mr. Vu Manh Hai</td>
<td>Senior fruit researcher of Research Institute of fruits &amp; vegetable</td>
<td>Ha Noi</td>
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</tr>
<tr>
<td>29</td>
<td>Mr. Chien</td>
<td>Director of Special forest product applied research center</td>
<td>Ha Noi</td>
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</tr>
<tr>
<td>30</td>
<td>Ms. Vu Ngoc Diep</td>
<td>Librarian o FAO library</td>
<td>Ha Noi</td>
<td>24.10.96</td>
</tr>
</tbody>
</table>
In addition, around 55 households were interviewed in Bang Lung (40) and in the pilot villages (15).

**Annex 13: Places visited during the field activities**

- Visit to pine and secondary mangletia plantations in Dong Vien commune
- Following of fuelwood collection and transportation by the commune women from the secondary mangletia plantation.
- Visit to Coc Thu pilot village at Ngoc Phai Commune, searching of a locally manufactured circular saw bench of the village chief and secondary natural forest areas in Ba Bo village.
- Visits to mangletia forest plantation in Ban Lang Commune, small scale mining station in Ban Lung town (using a locally made skyline system for transportation of Minerals) and Na Tum pilot village; where forest and manual wood processing tools and equipment were searched. Also a blacksmith’s workshop and private small scale pitsawing unit in Bang Lung town were visited.
- Visit to Ban Trang and Na Ang pilot villages in Dong Lac Commune where a secondary natural forest areas were visited and discussions with the village Chief were held on forest extension issues. Visit to small scale furniture manufacturers (contractors from the other province) in the private household group was organised.
- Visit to primary natural forest logging area in Khau Hau village in Yen My commune. In the area visited the local forest contractors were doing indigenous forest harvesting operations by handtools (axes, knives etc.) and with animal skidding (buffaloes) for the Forestry Enterprise. Also pitsawing operations were implemented at the logging site to produce ready made sawn timber.
- Visits to a small scale sawmill and furniture manufacturing companies in Bang Lung town were executed.

**Annex 14: List of Contacts by Technology Study Team**

<table>
<thead>
<tr>
<th>No</th>
<th>Name</th>
<th>Company/Organisation</th>
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<tr>
<td>1</td>
<td>Mr. Le Quang Dan</td>
<td>Director of Bac Can forest processing enterprise</td>
<td>Bac Can</td>
<td>20.10.96</td>
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<tr>
<td>2</td>
<td>Mr. Pauli Mustonen</td>
<td>Embassy of Finland</td>
<td>Ha Noi</td>
<td>21.10.96</td>
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<tr>
<td>3</td>
<td>Prof. Dr. Ha Chu Chu</td>
<td>Director of Forest Science Institute of Vietnam</td>
<td>Ha Noi</td>
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<tr>
<td>4</td>
<td>Dr. Tran Tuan Nghia</td>
<td>Research Officer of Forest Science Institute of Vietnam</td>
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<tr>
<td></td>
<td>Mr. Duong Quoc Tuan</td>
<td>Vice Director of Dong Thap Company Industrial Department</td>
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<tr>
<td>6.</td>
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<td>Director of To Hop Tac Ba Trieu Company</td>
<td>Ha Noi</td>
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<td>7.</td>
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<td>Bamboo Mat Village</td>
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<td>8.</td>
<td>Mr. Thieu</td>
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<td>13.</td>
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<tr>
<td>15.</td>
<td>Mr. Hai</td>
<td>Manager of Ice-cream Manufacturing Company</td>
<td>Ha Noi</td>
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<td>16.</td>
<td>Mr. Binh</td>
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<tr>
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<td>Cho Don</td>
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<td>Associate Director, University of agriculture and forestry</td>
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